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LEARNER RESPONSE, FEEDBACK, AND REVIEW IN FILM PRESENTATION.
FINAL REPORT.

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IN A STUDY OF THE EFFECTS ON LEARNING OF A FILM ON OCEANOGRAPHY, 477 GRADE 6 STUDENTS WERE RANDOMLY ASSIGNED TO A CONTROL GROUP NOT VIEWING THE FILM AND TO 12 TREATMENT GROUPS. INDEPENDENT VARIABLES WERE RESPONSE MODE, FEEDBACK (IN FORMS THAT PRESENTED AUDIOVISUAL OR AUDIO-ONLY FEEDBACK, PRESENCE OR ABSENCE OF CORRECT ANSWERS, AND SPACED OR DELAYED MASSED FEEDBACK), AND REVIEW MODE (FOR WHICH NO STUDENT RESPONSES WERE PERMITTED). AN ADDITIONAL GROUP THAT VIEWED A NON-EXPERIMENTAL VERSION OF THE FILM LEARNED AS MUCH AS ANY OF THE OTHER GROUPS IN HALF THE TIME. SCORES ON AN IMMEDIATE POST-TEST OF GROUPS RECEIVING FEEDBACK WERE SIGNIFICANTLY SUPERIOR TO THOSE FOR NO FEEDBACK, BUT NO RESPONSE MODE WAS SUPERIOR UNDER ANY FEEDBACK CONDITION. THERE WERE NO SIGNIFICANT DIFFERENCES AMONG ANY OF THE REVIEW CONDITIONS. SUBJECTS' MENTAL ABILITIES DID NOT AFFECT SCORES, BUT LOW VOCABULARY ACHIEVEMENT DID SHOW AN INTERACTION EFFECT. THE LACK OF SIGNIFICANT EFFECTS WAS INTERPRETED THIS WAY--FREQUENT REPETITION, EVEN IN THE NONEXPERIMENTAL VERSION OF CONCEPTS TO BE LEARNED MAY HAVE MASKED DESIRED EFFECTS OF THE EXPERIMENTAL VARIABLES. (LH)

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Final Report

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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SUMMARY

Three sets of variables were investigated in this study: modes of eliciting student response to motion picture stimuli, modes of furnishing feedback and knowledge of the correctness of the response, and modes of review of the presented stimuli.

Objectives

The purpose of the study was to compare the effectiveness of a sound motion picture film in sixth grade general science under the following conditions:

1. By three different methods of eliciting active learner response: overt constructed response, covert participation response, and expository no response.

2. By five different methods for giving the subject knowledge of the correctness of his response (feedback): spaced audiovisual feedback with correct answer, spaced audio only feedback with correct answer, spaced audiovisual feedback without correct answer, delayed massed audiovisual feedback with correct answer, and no feedback.

3. By three different methods for presenting the subject with a review of the content: spaced audiovisual review, spaced audio only review, and delayed massed audiovisual review.

4. For learners with different mental ability and vocabulary achievement characteristics.

Procedure

A basic instructional sound motion picture was produced on the subject of "Oceanography" and modified into 13 experimental treatments so as to study the response/feedback variables in combination and the review variables alone. A total of 477 sixth grade students were randomly assigned to the 13 film treatment groups and a control group that did not view the film. The overt and covert response groups made active responses during the film showings to questions in workbooks. Feedback to these responses were given under the five conditions named above. The review groups made no responses, but viewed the feedback sequences. A basic film, containing no response, feedback, or review, was included. Subjects were tested immediately after the presentation of the films on a 67-item performance test of knowledge, comprehension and application. Qualitative measures of student reactions were also obtained. Analysis of the results was made by analysis of variance and covariance, factor analysis, correlation analysis, and t-test comparisons.

Results and Conclusions

The results and conclusions are summarized below for the major comparisons, the learner characteristics, and the qualitative reactions:

1. The basic conventional film resulted in as great a learning gain as any of the other experimental treatments.

2. There was a tendency for the feedback of the knowledge of correctness of response to be more effective than the absence of such feedback.

3. Neither overt nor covert responses were found to be superior to the other under any of the feedback conditions.

4. There were no significant differences in learning among any of the review conditions.

5. There were no significant differences in the performance of subjects with different mental abilities to the different experimental variables.

6. Subjects with lower vocabulary achievement interacted more variably with the different experimental variables than did those with higher vocabulary achievement.

7. The patterns of performance on the knowledge and comprehension subtests were similar to that on the total performance test, but the application subtest showed more variability of results.

8. Test items previously practiced in the workbook were not learned appreciably better than those test items that received no workbook practice.

9. All groups responded positively to the material presented, but they considered the films to be somewhat long and the test fairly easy.

CHAPTER I

INTRODUCTION

Fundamental to effective use of educational media is the design of the messages that pass through them. Variations in message design, in combination with available media and known characteristics of learners, create a complex pattern of interacting relationships that calls for research of commensurate complexity. This study was part of a comprehensive search for invariants in this pattern of relationships. Such stable factors, once identified, will become the empirical basis for the systematic development of principles of message design.

The Problem

In this study, controlled experimentation was used to investigate incremental presentation of a unit of instructional material on film. Each increment was tested immediately and the results were fed back to the learner, or each increment was reviewed either during or after the film. By thus combining several methods of presentation into a single experimental study, comparative assessment under controlled conditions became possible for selected message designs.

Specifically, the study assessed different modes of student response when used with variations in feedback of knowledge of results or review of the material presented; compared the relative effectiveness of immediate feedback of knowledge of correct response and delayed feedback; sought to establish whether or not practice effect or feedback following a response was operating when knowledge of correct response was furnished; and compared the effectiveness of spaced review sequences throughout the film and massed review material at the end of the film. Each response-feedback variable was also studied in relation to selected learner characteristics.

Systematic study of specific factors in the design of messages for learning through audiovisual media has only recently begun. Previous research was directed primarily to evaluative comparisons among the several media and techniques of their use. Now, a search for invariants that contribute to the increased effectiveness of discrete learning units (messages) is under way. This study is part of that effort.

In particular, this study has addressed itself to the measurable roles played in learning through media by guided response techniques and the subsequent feedback of knowledge of correct responses. It was believed that these procedures, until recently largely confined to verbal programed materials, have demonstrable possibilities for increasing the instructional impact of projected materials. Prior research has pointed to the need for controlled manipulation of several related variables, alone and in combination, each step contrived to permit multivariate analysis of experimental and descriptive data. This study was designed and conducted to meet this projected need.

The study had as its major objective the determination of the effects of active learner response, feedback of knowledge of the correctness of the response, and repetitive review upon learning from a general science film. The specific objectives studied were:

1. To determine the effects of making active overt or covert learner responses to workbook questions.

2. To determine the effects of receiving feedback of knowledge of correct response, either immediately or when delayed, and of receiving no feedback.

3. To determine the interactions of the different kinds of learner responses with the different kinds of feedback of knowledge of correct response.

4. To compare the effects of audiovisual and audio immediate review and massed delayed review of major concepts presented.

5. To establish the learning effects of a conventional expository no-response film.

6. To determine the relationships between the various stimulus modes and specified learner characteristics (mental ability and vocabulary achievement).

7. To determine the effects of the various stimulus modes upon subtest questions measuring knowledge, comprehension, or application of learning.

8. To determine the effects of the various stimulus modes upon learning performance test questions practiced or not practiced in the workbook.

9. To examine attitudinal and qualitative data that might indicate the learners' condition or reactions during the experiment.

Procedurally, the problem was to produce a referent motion picture about the subject of oceanography to be presented in three learner-response modes (overt constructed response, covert participation response, and straight expository with no response) combined with four feedback or review modes (immediate audiovisual feedback, immediate audio-only feedback, delayed audiovisual feedback, and no feedback at all). In addition to these twelve versions, a thirteenth was created to test the effects of presentational techniques used in the feedback versions. The thirteen films were shown to experimental groups drawn from a population of sixth-grade subjects. Effects were measured by tests specially developed for the experiment. A control group was also tested to establish prior learning of the subject matter used.

Review of Related Research

The research will be reviewed in several sections, each treating a class of variables related to the problems under study: active learner response, feedback and knowledge of correct response, and repetition and review.

Active Learner Response

The eliciting of active student response in relation to instructional media has been studied in a number of experiments and found to be effective in promoting learning (Allen, 1960; Cook, 1960; Lumsdaine, 1963). Although such responses may assume different forms, this study directed itself to an investigation of two kinds of responses: overt written response and covert mental response.

Overt written response. The overt form of student response, either by writing answers or calling-out answers, has generally been favored by experimental evidence from audiovisual studies over conditions where no response was elicited. For example, Hovland, Lumsdaine and Sheffield (1949), using a sound filmstrip on the teaching of the phonetic alphabet to Army recruits, found a decided superiority for the method in which the subjects called-out their responses to stimuli as contrasted with passively viewing the stimulus without overt response. Lumsdaine and Gladstone (1958) later substantiated these findings. Jaspen (1950), testing naval trainees in gun assembly, found active participation to be superior only when the film had a slow enough rate of development to permit the learners time to respond. Kurtz and Hovland (1953) found that elementary school children who verbalized at the time they observed familiar stimulus objects recalled more items correctly and made fewer incorrect responses than the non-verbalization group. Gropper and Lumsdaine (1961) compared the relative effectiveness of a conventional junior high school science television lesson and a television lesson using sequenced or programed material that encouraged active student response. They found that when the television teacher paused just prior to expected responses to allow students time to complete the statements begun and then "fed back" the correct response, learning was reliably increased. More recently, Gropper (1966) compared the gains in verbal test scores by eighth grade students between groups that made an active response to programed visual science demonstrations and those that watched the demonstrations passively without responding. Not only did the active response group perform at a higher level immediately after the presentation, but increased its superiority significantly over the nonactive response group over a four-month period and retained almost all of its original verbal learning.

Covert participative response. The covert type of participation has been most commonly studied in connection with "question-posing" stimuli, usually eliciting a mental response by the student. Lumsdaine, May and Hadsell (1958) showed that the instructional effectiveness of a film could be increased by splicing in "thought-provoking" questions designed to stimulate curiosity. Hall (1936) also reported an increase in the amount of learning when relevant questions were flashed on the screen during a silent film. However, Lumsdaine (1958) found only a slight tendency for improvement through the use of rhetorical questions in the narration of a fifth grade science film, and Kantor (1960) found no increase in learning when he inserted questions (both aurally and visually) into the content of a seventh grade science film.

Overt versus covert response. In the several cases where overt and covert responses to audiovisual presentations have been compared, the results were indecisive. Michael and Maccoby (1953) found no significant difference between the effects of these two kinds of responses when a civil defense film was stopped periodically to permit the high school subjects to answer questions on the factual material just viewed. This finding was confirmed by Kanner and Sulzer (1961). Silberman (1962) reported a number of studies in programed instruction that showed no differences between overt and covert response modes, but concluded that the covert response mode resulted in more efficient learning. Holland (1965) concluded, in a review of programed instruction research, that the overt response mode could be favored over the covert response mode when the items were properly designed and the programs were long enough. However, he did note that enough doubt had been raised about this issue to warrant considerably more research.

Feedback and Knowledge of Correct Results

Numerous studies have been reported by Allen (1960) and Lumsdaine (1961,1963) confirming the value of "feeding-back" to the learner knowledge of results reinforcement, or confirmation of the correctness of his previous response to stimuli presented. No studies were found, however, that compared the effectiveness of different feedback channels, such as "audio alone" vs "audio and visual" in combination. Also, Lumsdaine (1963) implied a need for studies that would determine the functions of "immediate knowledge of correct results" with the influence of the additional practice trial (which accompanies such feedback) ruled out.

Repetition and Review

A number of studies have been reported by Allen (1960) indicating that the repetitive use of a film will result in significantly increased learning. When repetition and participative response were compared, Lumsdaine, May and Hadsell (1958) and Kurtz, Walter and Brenner (1950) all found that showing a film twice was about as effective as showing it only once with participation questions or statements inserted. Although research in learning showed that spaced practice is more effective than massed practice, Miller and Levine (1952) found that the massing of review material at the end of a high school science film was significantly more effective than spacing the review sequences through the film following each major topic.

CHAPTER II

METHOD AND PROCEDURES

Controlled experimentation was used to assess the combined effects of several variables upon learning. Multiple treatments of stimulus motion picture films were presented to randomly selected groups of sixth grade elementary school students. Multivariate analysis was used to compare effects and to relate these to characteristics of the learners.

Experimental Design and Method

Three sets of variables were manipulated in the study: modes of eliciting student response to motion picture stimuli, modes of furnishing feedback and knowledge of results of the correctness of the response, and modes of review of the presented stimuli. The effects of these variables upon the learning of the content presented in the stimulus film were compared in various combinations and are shown graphically in Figure 1.

Experimental Variables

Learner response modes. Three different methods of eliciting active learner response (or no response) were designed into the experimental film treatments (shown graphically in Column 3 of Figure 1):

1. Overt constructed response, in which the stimulus film was stopped after each of eleven expository sequences, at which time the subjects made written responses to questions printed in a workbook. These questions concerned content just viewed in the film, and the question was also presented on the sound track of the film. This mode was used in Treatment Nos. 1, 3, 5, 7, and 13.

2. Covert participation response, in which the stimulus film was stopped after each of the same eleven expository sequences, at which time the subjects were directed "to think" (rather than "to write") the answers to the same questions in the workbook. These instructions and the questions were also presented on the sound track of the film. This mode was used in Treatment Nos. 2, 4, 6, and 8.

1. Treatment Number	2. Expository Sequence	3. Response Mode	4. Feedback or Review Mode		5. Expository Sequences	6. Massed Feedback or Review
1	A	Overt	Audiovisual Feedback	Correction	B...K	
2	A	Covert	Audiovis. Feedback	Correction	B...K	
3	A	Overt	Audio Feedback	Correction	B...K	
4	A	Covert	Audio Feedback	Correction	B...K	
5	A	Overt			B...K	
6	A	Covert			B...K	
7	A	Overt			B...K	Audiovisual Feedback
8	A	Covert			B...K	Audio Feedback
9	A				B...K	
10	A		Audiovisual Review		B...K	
11	A		Audio Review		B...K	
12	A				B...K	Audiovisual Review
13	A	Overt	Audiovisual Feedback		B...K	
14	Control Group (test only; no film)					

Figure 1. Graphic Description of Experimental Treatments

3. _Expository no response_, in which the same expository sequences as in the overt and covert treatments were presented on film, but the film was not stopped, no questions were asked, and thus no opportunity for directed response was provided. This version was considered to be comparable to the conventional instructional film. This mode was used in Treatment Nos. 9, 10, 11, and 12.

Feedback and knowledge of results modes. Five different methods for giving the subject knowledge about the correctness of his response ("feedback") were also designed into the experimental film treatments (shown graphically in Columns 4 and 6 of Figure 1):

1. _Audiovisual feedback with correct answer_, in which short excerpts were taken from each of the expository sequences just presented and reshown after the student responses were made. In addition, the relevant page of the workbook, with the correct answers clearly indicated, was projected on the screen long enough for the subject to check and correct his response. This mode was used in Treatment Nos. 1 and 2.

2. _Audio only feedback with correct answer_, in which only the audio sound tracks of the same short excerpts from the expository sequences just presented were played after the student responses were made. In this case the correct answers to the workbook questions were presented orally on the sound track. This mode was used in Treatment Nos. 3 and 4.

3. _Audiovisual feedback without correct answer_, in which the short excerpts were taken from each of the expository sequences just presented and reshown after the student responses were made, but the correct answers from the workbook were _not_ projected as was the case in Treatment Nos. 1 and 2. This mode was used in Treatment No. 13.

4. _Delayed audiovisual feedback with correct answer_, in which all of the eleven short excerpts taken from each of the expository sequences were massed at the end of the film rather than being spaced throughout the film after each sequence. In addition, the relevant pages of the workbook, with the correct answers clearly indicated, were projected on the screen after each excerpt and long enough for the subject to check and correct his responses. This mode was used in Treatment Nos. 7 and 8.

5. _No feedback_, in which no feedback of any kind was made after the learner response, the film going immediately to the next sequence. Therefore, the learner obtained no indication of the correctness of his response. This mode was used in Treatment Nos. 5 and 6.

Review. Three different methods for presenting the subject with a review of the content of the stimulus film were designed into the experimental film treatments (shown graphically in Columns 4 and 6 of Figure 1):

1. Audiovisual review, in which the identical short excerpts taken from each of the expository sequences just presented and used in the response/feedback modes were reshown without student response. Thus, without provision for student response, these excerpts served as a review rather than a feedback function. This mode was used in Treatment No. 10.

2. Audio only review, in which only the sound tracks of the same short excerpts from the expository sequences just presented were played immediately following the expository sequences without intervening student response. This mode was used in Treatment No. 11.

3. Massed audiovisual review, in which all the eleven short review excerpts taken from each of the expository sequences were massed at the end of the film rather than being spaced throughout the film after each sequence. This mode was used in Treatment No. 12.

Control group. The control group viewed none of the films, but took the performance test only. This group served as a baseline to determine whether or not there was learning from the experimental films.

Experimental Design

The design of the study called for the development of the 13 experimental treatments described above, the administration of these treatments to experimental subjects under controlled conditions, the testing of performance of the subjects by means of a post-test given immediately following exposure to the stimulus material, and the comparison of the performance data by means of appropriate statistical techniques. The subject matter of the stimulus film was "Oceanography," a subject not included in the normal sixth-grade curriculum yet comprehensible to that age group. Subjects were 477 sixth-grade students from the Pasadena Unified School District (California), randomly assigned to the different experimental treatments.

Comparisons of the performance data were made for various combinations of the 13 treatments and a control group (which did not view the film, but took the performance test). These comparisons were made for the total groups, for high vs low mental ability groups, for high vs low vocabulary groups, for the total groups on the three subtests (knowledge, comprehension, application items), and for subtest items practiced in workbook vs those items not practiced. In addition, qualitative reactions of the subjects to the treatment modes were compared.

Experimental Population

The total experimental population consisted of 477 sixth-grade students drawn from five elementary schools in the Pasadena Unified School District (California). The subject used comprised the total sixth-grade population of these schools. An additional group of about 100 sixth-grade students from another Pasadena elementary school provided subjects for the two tryouts of the performance test, the workbooks, and preliminary versions of the stimulus film.

A rotational scheme was devised for assigning segments of each school to one of the fourteen groups. This device was necessitated by variations in the socioeconomic levels of the schools and the need to equalize this factor among all the experimental groups. Using a table of random numbers, subjects were then assigned randomly to each segment, comprising part of a treatment group.

Development of the Experimental Stimulus Materials

The films used in the experiment met several stringent requirements: their content had to be understandable by the subjects, yet provide sufficiently novel information to minimize effects of prior knowledge and to permit development of a range of test items; the narration had to be meaningful without visual support in the feedback sequences to permit creation of the audio-only treatments; the visual elements had to be readily available either from existing films or through use of art work in simple animation; and the longest edited versions could not run longer in time than a normal class period, including the overt and covert responses to workbook questions.

Subject Matter

Curriculum guides used in the school district were studied in search of content that would meet these criteria. The resulting list--which included various aspects of perception, meteorology, information processing and transmission, navigation, and oceanography among its 28 possibilities--was shown to several sixth-grade science teachers. Each independently selected oceanography, and two heads of science departments placed particular emphasis upon physical oceanography.

Several meetings followed with Dr. H. Bradner and his staff at the Scripps Institute of Oceanography in La Jolla, California. During these conferences, the topics possible in physical oceanography were narrowed to the physical attributes of ocean ecology: in particular, light, temperature, and pressure. Later script development reduced these to light and temperature.

Scripts and Workbook

Considerable research was undertaken to provide accurate informational bases for the stimulus films, including extensive review of existing instructional films. An outline was prepared, and a first-draft version of film Treatment No. 1 (the overt response, audiovisual feedback treatment) was attempted. Difficulty was encountered in providing richness of content for testing yet not exceeding the level of understanding of the subjects and at the same time managing to meet the multiple controls demanded by the many variables in the study.

The workbook (see Appendix B) was developed in parallel with the script (see Appendix A) and items for the criterion performance test (see Appendix C). This process was primarily one of reduction from among a great many alternative solutions to that combination that met the interlocking criteria required of the study. Once the first script had been created, the other eleven developed rather quickly. Although production of the films began upon completion of the first script, changes were introduced as required by the subsequent scripts and by the test items.

Experimental Film Production

Film Treatment No. 1 (see Figure 1) contained within it all elements of the other twelve films; so it was produced first. The final script for that film may be seen in Appendix A. A large number of existing instructional films and a great deal of undersea research footage was surveyed for materials that would fit the requirements of the study. Relevant materials were obtained for duplication and combined with original animated art work and original live footage photographed especially for the experiment.

The film was edited in several stages. A rough cut was made to organize the collected and specially prepared footage. After review on a picture-sound interlocked projector, and after consequent major modifications had been made, finer cuts were undertaken to fit a preliminary narration. No optical effects, such as fades, dissolves, etc., were used in the film. The resulting film was then pretested with students in a Pasadena elementary school. Analysis of test items, data from interviews with students, and observations by the staff all provided a basis for further modifications in the narration and visual material of the film. The revised film and test items were then tried out again, and again changes were made to develop or to simplify concepts found to be difficult by the subjects. For example, it was found that the subjects did not understand the relationship between the production of chemicals by bacteria at the bottom of the sea and the chemical feeding of plants at the surface. By animating the pattern of flow between these two levels, the concept was clarified.

Final narration for the first film included recording of the brief introductory and transitional elements needed for the other treatments. Appropriate footage was then fitted to the narration, checked on an interlocked projector, and then printed. In this way the requisite number of treatments were created under careful control of a project staff producer.

The Measuring Instruments

Performance Test

Description of the test. The performance test (see Appendix C) consisted of 67 verbal items, employing multiple-choice, true-false, completion fill-in, open-ended short answer, and ordering construction. Item types written for the performance test incorporated tasks defined by Bloom (1956) as Knowledge, Comprehension, and Application. The test included 32 Knowledge items, 19 Comprehension items, and 16 Application items. In addition, the 67 test items were categorized as having been practiced (19 items) or not practiced (48 items) in the workbook activity.

Test development. All performance test items were developed through a tryout-revise-tryout cycle. Draft items designed to measure knowledge, comprehension, and application were prepared to sample each of the eleven major sequences in the films. These items were then reviewed by the staff and three psychometricians.[1] Revised items were tried out with the first draft version of Film Treatment No. 1. Scores were analyzed on an IBM 1401 computer, using phi and biserial programs provided by the Testing Bureau of the University of Southern California. Further revisions were then made and tried out with a second sample of the population. Minor revisions were made to refine the performance test before it was finally used in the experiment.

Reliability of the performance test, as used with the experimental group in the first tryout and as determined through use of Kuder-Richardson Formula #20, was .87. The reliability calculated for the control group was .65. The mean score for the first tryout experimental group was 30.17 and for the control group (subjects who saw no stimulus film) was 22.17, giving a difference score of 8.0. Reliability of the performance test as used in the second tryout was .91 with a mean score of 35.88. The reliability estimate of the performance test computed from the comparable experimental version (Treatment No. 1) in the final experiment was .92, and the reliability for the control group was .83. The mean score of the group that saw Film Treatment No. 1 was 42.41, and the mean score of the control group was 25.55, with a difference of 16.86.

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[1] Dr. Paul Christensen, Human Factors Research Corporation, Santa Barbara, California; Dr. Philip Merrifield, Kent State University, Kent, Ohio; and Mr. Donald Estavan, Estavan Associates, Inglewood, California.

Workbook Development

The workbook questions (see Appendix B) were developed in parallel with the stimulus films and the performance test measure. Questions were designed to promote rather than to measure learning. Comments from teachers during the tryout period were elicited, students were interviewed, answers to the questions were examined, and related questions on the performance test were analyzed to guide refinements in workbook items.

Intelligence and Achievement Tests

The California Test of Mental Maturity scores were used to provide Total, Language, and Non-Language Quotient scores. The Iowa Tests of Basic Skills were used to provide scores for Vocabulary, Reading Comprehension, Language Skills, Arithmetic, and Work-Study Skills.

F Battery

The test comprising the F Battery were assembled to measure certain capabilities of students, which, when evaluated with available IQ and achievement scores, might improve predictions of performance with audiovisual materials. This test was administered to all subjects two weeks after their exposure to the experimental stimuli. The expectation was that, if the F Battery would be useful in improving predictions in this context, it could be utilized when forecasting performance with similar stimulus materials. Explorations could then follow of the relationship of student abilities, not normally assessed by intelligence measures, and how performance and these abilities were related to certain combinations of instructional stimuli.

The F Battery was constructed by selecting a number of tests identified as being factorially unique by the research staff of the Psychological Laboratory of the University of Southern California (Guilford & Hoepfner, 1963). All the tests selected were based upon the "Structure of Intellect" model (Guilford, 1955). This model provided for a logical and systematic placement of every "known" intellectual ability. The tests chosen had been identified as being related to one of some 55 different intellectual abilities ascertained through the use of multiple-factor analysis by the Aptitudes Project of the Psychological Laboratory. The test battery itself had been assembled for use in an earlier experiment (Allen, Filep and Cooney, 1967).

In addition to factorial uniqueness, the tests selected were based upon: (1) prior use and reliability with a preadolescent/adolescent population, (2) dissimilarity to subtests of the IQ and achievement measures, and (3) relationships to tasks required in responding to the stimulus materials provided in the programed sequences.

Tests were selected that measured the student's ability to identify, compare and contrast, and construct graphic figures. The specific tests that were selected measured the student's ability: to judge quickly and accurately units of figural information as being identical or dissimilar, to produce many simple figures that conformed to given specifications, to produce changes in figures that altered the meaning significance or use of elements, to classify the same items of figural information in different ways, or to place events in correct sequence.

Semantic Differential

The *Semantic Differential* instrument consisted of eleven 7-point scales defined by adjective pairs representing three factors: Evaluative, Potency, and Action (see Appendix D). The rationale, construction, and analysis of this instrument has been described in Osgood, Suci, and Tannenbaum (1957).

Evaluative	Potency	Activity
good-bad	strong-weak	fast-slow
work-play	heavy-light	repetitious-varied
cruel-kind	feminine-masculine	loud-soft
pleasant-unpleasant		active-passive

The concept, "THE *STORY* YOU SAW ABOUT THE ECO-SYSTEM " was to be rated on each of the eleven scales. The scales were printed on mask sense forms so that scoring machines could be used to transfer the data to punched cards.

Student Reaction Questions

A student reaction scale, consisting of five 5-point scales, and three open-ended questions were constructed to elicit ratings and reactions relative to the students' perceptions of the length of the film, liking for the film, learning from the film, test difficulty, helpfulness of the workbook in learning the material, and trouble understanding the film. (see Appendix D).

Conduct of the Experiment

Schedules and procedures were worked out in detail with the administrative staff of each school and then were reviewed with the teachers of the classes involved in the experiment. At the times of the experimental runs, the subjects met in their home rooms and were then taken to the appropriate experimental rooms as determined by their random assignment. The experimental rooms were regular classrooms set up for film projection. Students not scheduled for the first presentation were supervised on the playground or in a study hall, whichever contingency disturbed their normal schedules the least. All subjects in the experimental rooms were presented with the instructions, the stimulus films and workbook exercises, and then tested immediately with the performance test. Following the administration of the experiment, these subjects were then moved to the playground or study hall, and the second experimental group was brought to the experimental rooms. Contact was avoided between these two experimental sections by keeping them separated during the passing periods.

Two weeks later the F Battery, semantic differential measure and the student reaction questions were administered to all the subjects, either in their own classrooms as intact class groups or in combined groups in cafetoriums, whichever was most convenient at the school.

Preparation of Data and Statistical Analysis

Recording the Data

All quantitative data were to be analyzed by computer; so appropriate formats were set up that would simplify detection and correction of errors in scoring of tests and in transfer of descriptive data from school records to the numbered cards used in the analysis.

During the experiment, subjects marked their answers directly on the test booklets.[2] These booklets were then grouped by treatment and scored twice independently on sensescore sheets. Guide keys (see Appendix C) were provided to each of two scorers to indicate acceptable and unacceptable answers. The two sensescore sheets for each test booklet were then compared, and differences were resolved for all tests by a third individual. Percentages of differences ranged among experimental groups from a low of 1.5% for the group that saw film number 9 to a high of 3.2% for the group that saw film number 2. The mean percentage of difference was 2.3% for all groups, the percentage of all scored items that required interpretive resolution of differences between scorers.

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[2] It was found during the tryouts that subjects had serious difficulty relating numbered items accurately to the sensescore sheets; so subjects marked answers directly in the test booklets.

Estimates of abilities and general achievement were provided from school records (Iowa Tests of Basic Skills and the California Test of Mental Maturity). Numbers assigned to students for purposes of randomization were used throughout the analysis to preserve the anonymity of the subjects and the integrity of their school records. IBM cards were punched manually from the lists of student data. The multi-part F Battery, used to measure selected aptitudes, was also scored once by each of two different scorers. Initial differences were resolved in conference with a third party to establish reasonable correct criteria. This approach eliminated most of the conflicting assessments. The remainder were brought to the third party for decision. Scores were transferred to sensescore sheets for mechanical transfer to IBM cards.

All sensescore sheets, including those for the semantic differential, were processed by the University Testing Bureau. Resulting cards were then sorted and analyzed by machine for descriptive characteristics (listing, ranges, means, frequency, counts, etc.). These results provided a basis for "cleaning" the cards of errors. This cycle was repeated until all observable errors were removed.

Statistical Techniques and Computer Program

A series of descriptive analyses were undertaken to establish the quality of the data, to identify characteristics of the population and interrelationships among selected variables, and to provide a basis for selecting covariates to be used in the comparative analyses. All these analyses were undertaken on the Honeywell 800 computer, operated by the staff of the Computer Sciences Laboratory, University of Southern California. All computer programs used were created or adapted for use on this machine by senior staff members of the Laboratory. In particular, factor analytic and covariance programs used were adapted versions of the BMD03M and BMD05V programs, respectively, described in Dixon (1965).

The principal components factor analysis used provided means and standard deviations, a correlation matrix, and a factor matrix useful in the selection of covariates for later analyses. An orthogonal rotation to the varimax criterion was performed on six factors.

Analyses of variance and covariance were undertaken to establish the statistical differences among the experimental variables and to adjust the test scores for differences among the groups in vocabulary achievement and non-language I.Q.

CHAPTER III

RESULTS

Test results were analyzed for total post-test performance, for post-test performance by high vs low mental ability groups, for post-test performance of high vs low vocabulary ability groups, for the total groups on the three subtests (knowledge, comprehension, application items), and for total groups on the subtest items practiced in the workbook vs those items not practiced. In addition, qualitative responses on the semantic differential measure and reactions to the presentation were compared for all groups.

Descriptive Analyses

Homogeneity of Variance

Frequency distributions, associated polygons, and plots were computed to provide an estimate of homogeneity of variance among groups. Kurtosis of the distribution of raw scores was found by calculation to be significant at the .05 level.[3] However, after evaluation of this estimate, in view of the graphic descriptions mentioned above, and in view of current estimates of its effects in the analyses to be undertaken, sufficient confidence was held in the data to proceed (Kerlinger, 1964, pp. 258-259).

Selection of Covariates

Covariates for the analysis of covariance were selected by performing correlation and factor analyses of the test scores. Three criteria were used in the selection of the covariates. The first required that the covariates selected be meaningful in the context of the study to members of the educational community who might be using the reported results. Second, since only two covariates were to be used, it was important that one covariate have a large loading on one factor and the other covariate have a large loading on another factor. Third, these two covariates also had to have a low correlation with each other and a significant correlation with the total performance post-test.

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[3] Calculated on the Honeywell 800 computer with a program prepared by Richard Wolf and Leopold Klopfer, entitled "Test Scores and Statistical Analysis 2," of the Graduate School of Education, University of Chicago.

The covariates selected were Non-Language IQ and Vocabulary achievement. Both of the covariates selected were measurable by existing tests, thus meeting the first criterion. Examination of Table 1 shows that Non-Language IQ had a high loading (.476) on Factor 3 and that Vocabulary achievement had a high loading (.866) on Factor 1. Table 21 in Appendix E shows these two covariates to have a .41 correlation with each other, which was moderate within the range of possible covariates to be considered. Non-Language IQ correlated .45 with the total performance post-test, and Vocabulary achievement correlated .76 with that test.

TABLE 1

ROTATED FACTOR LOADINGS USED AS A BASIS FOR SELECTING COVARIATES APPLIED IN THE ANALYSIS OF COVARIANCE (N = 381)

Variable	Factors					
	1	2	3	4	5	6
Vocabulary	.866	.161	.198	.028	.166	-.157
Reading	.835	.115	.328	-.113	.182	-.105
Language Skills	.660	.256	.496	.393	.113	.063
Work Study	.569	.398	.545	-.020	.265	-.027
Arithmetic Skills	.539	.507	.580	-.097	.067	.091
Language IQ	.647	.173	.446	.100	.241	-.087
Non-Language IQ	.277	.207	.476	.065	.396	.065

Correlation of Variables

Correlations listed in Appendix E showed the performance post-test as being highly correlated with the achievement test scores, with IQ scores, and with the total F Battery score. The part scores (knowledge, comprehension, application) of the performance post-test also exhibited a high positive relationship to the intelligence, achievement, and total F Battery scores. On the other hand, sex had a -.11

correlation with the post-test score. The correlations between achievement scores and IQ and F Battery scores tended to be fairly high, and the correlations between the IQ scores and the total F Battery score was in the medium range.

Analysis of Total Performance

Mean scores and standard deviations for the total performance post-test and for the Knowledge, Comprehension, and Application subtests are presented in Table 2. Examination of the total uncorrected performance post-test scores for the thirteen treatment groups shows a range from 35.80 to 46.86, the Overt Response/Audiovisual Feedback Without Correction being the most effective and the Delayed Massed Review the least effective. The subtests followed the same pattern of effectiveness.

Comparative analyses among different combinations of the treatment groups were conducted in order to meet the specified purposes of the study. Means, uncorrected and corrected, will be presented with each analysis to show the differential effects of the covariates.

Response and Feedback Modes

Six separate analyses were made of the effects of the different learner response and feedback variables upon post-test performance. These analyses combined the response and feedback variables in different groupings in order to determine their individual and interacting effects.

All eight treatments in which overt or covert responses were made to the experimental stimuli were compared under the four different feedback conditions as represented in the following design matrix (with the film treatments indicated by their numbers):

	RESPONSE	
FEEDBACK	Overt	Covert
AV Immediate	1	2
Audio Immediate	3	4
No Feedback	5	6
AV Delayed	7	8

TABLE 2

TOTAL PERFORMANCE POST-TEST AND SUBTEST MEAN SCORES AND STANDARD DEVIATIONS FOR TREATMENT GROUPS (UNADJUSTED)

Treatment Group	N	Total Score (67 items)		Knowledge (32 items)		Comprehension (19 items)		Application (16 items)	
		$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
1. Overt/AV Feedback	34	42.91	12.90	21.56	6.42	13.12	4.10	8.24	3.25
2. Covert/AV Feedback	34	42.27	8.39	22.21	4.23	12.79	2.59	7.27	2.73
3. Overt/Audio Feedback	35	43.63	9.01	22.17	4.73	13.51	3.03	7.94	2.70
4. Covert/Audio Feedback	36	44.75	10.08	22.42	5.15	13.72	3.41	8.61	2.57
5. Overt/No Feedback	31	41.61	10.39	21.36	5.53	13.26	3.62	7.00	2.54
6. Covert/No Feedback	29	38.04	12.83	19.76	6.62	11.48	4.65	6.79	2.62
7. Overt/Delayed Feedback	29	44.14	9.93	23.10	5.03	13.38	3.37	7.66	2.54
8. Covert/Delayed Feedback	33	40.76	10.80	21.24	5.17	12.09	4.00	7.42	2.74
9. Expository No Response	30	43.57	11.17	21.87	4.94	13.37	3.90	8.33	3.37
10. AV Review	32	42.00	9.94	21.28	5.02	12.75	3.47	7.97	2.87
11. Audio Review	35	38.97	10.82	19.63	5.45	12.14	3.74	7.20	2.60
12. Delayed Massed Review	30	35.80	13.03	18.60	6.76	10.83	4.62	6.37	2.90
13. Overt/AV Feedback Without Correction	35	46.86	9.81	23.94	4.70	13.63	3.45	9.29	2.89
14. Control	33	26.64	7.92	11.94	3.90	8.70	3.04	6.00	2.73

A two-way analysis of covariance was performed on these data with Non-Language IQ and Vocabulary used as covariates. Table 3 presents the unadjusted and adjusted performance post-test means, the means for the two covariates, and the results of the analysis of covariance.

TABLE 3

RESPONSE VS FEEDBACK (ANALYSIS OF COVARIANCE)
(Covariates: Non-Language IQ and Vocabulary)

	N	Criterion		Covariate $\bar{X}$		Adjusted Criterion $\bar{X}$
		$\bar{X}$	σ	Non-Lang. IQ	Vocab.	
OVERT RESPONSE						
1. AV Immediate	34	42.91	12.90	105.03	68.35	43.06
3. Audio Immediate	35	43.63	9.01	106.03	72.60	41.47
5. No Feedback	31	41.61	10.39	112.26	69.32	40.60
7. AV Delayed	29	44.14	9.93	117.79	72.69	40.83
COVERT RESPONSE						
2. AV Immediate	34	42.27	8.39	106.35	67.65	42.66
4. Audio Immediate	36	44.75	10.08	102.64	71.78	43.32
6. No Feedback	29	38.04	12.83	110.17	66.90	38.49
8. AV Delayed	33	40.76	10.80	105.67	67.79	41.14

	df	SS	MS	F	Prob.
Feedback	3	410.89	136.96	2.96	< 0.05
Response	1	.67	.67	0.01	--
Interaction	3	131.96	43.99	0.95	--
Within	251	11605.48	46.24		

The analysis of covariance F-test showed a .05 level of significance among the feedback variables, but no differences were found between the response modes or the feedback-response interactions. The two active response modes (overt and covert) with either audiovisual or audio feedback of knowledge of correct response were the most effective modes of presentation, and the mode furnishing no feedback was the least effective.

The results were separately compared in one-way analyses of variance for each of the active response conditions (overt and covert) with the inclusion of the Expository No Response group (Film Treatment 9). The results of these two analyses are shown in Tables 4 and 5. No significant differences among the five treatment groups were found for the subjects making "overt" responses to the workbook exercises. However, a difference significant at the .05 level was found for those subjects making "covert" responses to the workbook exercises. The treatment giving no feedback to the covert response was the least effective of the five treatments. Despite the fact that the Expository No Response treatment contained no provisions for either active student response or feedback, it appeared to be as effective as any of the other experimental treatments.

TABLE 4

OVERT RESPONSE AND NO RESPONSE (ANALYSIS OF COVARIANCE)
(Covariates: Non-Language IQ and Vocabulary)

		Criterion		Covariate $\bar{X}$		Adjusted Criterion $\bar{X}$
	N	$\bar{X}$	σ	Non-Lang. IQ	Vocab.	
1. AV Immediate	34	42.91	12.90	105.03	68.35	44.71
3. Audio Immediate	35	43.63	9.01	106.03	72.60	43.03
5. No Feedback	31	41.61	10.39	112.26	69.32	42.18
7. AV Delayed	29	44.14	9.93	117.79	72.69	42.34
9. Expository No Response	30	43.57	11.17	104.43	72.13	43.37

	df	SS	MS	F	Prob.
Overt × No Response	4	128.54	32.14	.72	--
Within	152	6786.68	44.65		

TABLE 5

COVERT RESPONSE AND NO RESPONSE (ANALYSIS OF COVARIANCE)
(Covariates: Non-Language IQ and Vocabulary)

		Criterion		Covariate $\bar{X}$		Adjusted Criterion $\bar{X}$
	N	$\bar{X}$	σ	Non-Lang. IQ	Vocab.	
2. AV Immediate	34	42.27	8.39	106.35	67.65	42.87
4. Audio Immediate	36	44.75	10.08	102.64	71.78	43.88
6. No Feedback	29	38.04	12.83	110.17	66.90	38.68
8. AV Delayed	33	40.76	10.80	105.67	67.79	41.53
9. Expository No Response	30	43.57	11.17	104.43	72.13	42.29

	df	SS	MS	F	Prob.
Covert × No Response	4	471.54	117.89	2.62	$< .05$
Within	155	6987.90	45.08		

A two-way analysis of covariance was also performed to compare the performance of the four groups that received "immediate" audio-visual or audio feedback to either overt or covert responses, as represented in the following design matrix:

FEEDBACK	RESPONSE	
	Overt	Covert
AV Immediate	1	2
Audio Immediate	3	4

The results of the analysis are shown in Table 6. No significant differences were found between the two active response modes, between the two feedback modes, or for the interactions among these variables under conditions of "immediate" feedback of knowledge of correct response with the correct answers shown.

Another two-way analysis of covariance was performed to compare the performance of those groups receiving "immediate" spaced feedback of knowledge of correct response with those groups receiving the feedback delayed until the end of the film in a massed presentation. This comparison is shown in the following design matrix:

FEEDBACK	RESPONSE	
	Overt	Covert
AV Immediate	1	2
AV Delayed	7	8

TABLE 6

IMMEDIATE FEEDBACK VS RESPONSE (ANALYSIS OF COVARIANCE)
(Covariates: Non-Language IQ and Vocabulary)

		Criterion		Coviarate $\bar{X}$		Adjusted Criterion $\bar{X}$
	N	$\bar{X}$	σ	Non-Lang. IQ	Vocab.	
1. AV Immediate (Overt)	34	42.91	12.90	105.03	68.35	43.79
2. AV Immediate (Covert)	34	42.27	8.39	106.35	67.65	43.34
3. Audio Immediate (Overt)	35	43.63	9.01	106.03	72.60	42.28
4. Audio Immediate (Covert)	36	44.75	10.08	102.64	71.78	44.22

	df	SS	MS	F	Prob.
Immediate Feedback	1	3.27	3.27	0.09	--
Response	1	19.11	19.11	0.54	--
Interaction	1	49.81	49.81	1.41	--
Within	133	4691.93	35.28		

The results of the analysis are shown in Table 7. No significant differences were found between the two active response modes, between the two feedback modes, or for the interactions among these variables under conditions of "immediate" or "delayed" feedback of knowledge of correct response with the correct answers shown.

The final analysis of the response and feedback variables compared the performance of the Overt Response/Immediate Audiovisual Feedback (Film Treatment 1) with the correct answer given group with the Overt Response/Immediate Audiovisual Feedback without the correct Answer given group (Film Treatment 13). These two treatments were identical except that Treatment 13 did not provide the explicit feedback of the correct answers; that is, it did not show the correct answers for each page of the workbook on the screen. Subjects presented with Treatment 1 saw the relevant portion of the film and also saw the correct answer for each page of the workbook projected on the screen. The results of the one-way analysis of covariance are shown in Table 8. No significant difference in performance was found between the two groups, thus indicating that the addition of the correct workbook answer on the screen in addition to the review sequence presented after each response was not a contributing factor to learning.

In summary, the results on the six analyses of the response-feedback interactions revealed only two statistically significant comparisons--both for the feedback variables. Audiovisual or audio feedback of knowledge of correct response, either immediate or delayed, were found to be superior to no feedback at all. Although the differences were not statistically significant, there appeared to be a slight advantage for "immediate" audiovisual feedback of knowledge of correct response over "delayed" feedback massed at the end of the film under both overt and covert response conditions. There was no apparent advantage demonstrated for projecting correct workbook answers on the screen in addition to presenting a review sequence that served as feedback to the workbook response just made. Neither overt responses nor covert responses were found to be superior to the other under any of the feedback conditions. Finally, the Expository No Response treatment, in which no active responses were made nor feedback given, was as effective as any of the other experimental treatments.

Review Modes

A single one-way analysis of covariance was performed to determine the relative effects of the three modes of using review materials in the presentations. The review sequences were identical to the feedback sequences (without correct answer being shown), but performed a review function rather than a feedback function because they were made without student response. Comparisons were made among Spaced Audiovisual Review, Spaced Audio Review, and Delayed Massed Audiovisual Review (at end of film). The Expository No Response treatment was added to the analysis as a means of comparing the review variable with the

TABLE 7

IMMEDIATE AND DELAYED FEEDBACK AND RESPONSE
(ANALYSIS OF COVARIANCE)
(Covariates: Non-Language IQ and Vocabulary)

		Criterion		Covariate $\bar{X}$		Adjusted Criterion $\bar{X}$
	N	$\bar{X}$	σ	Non-Lang. IQ	Vocab.	
1. AV Immediate (Overt)	34	42.91	12.90	105.03	68.35	43.46
2. AV Immediate (Covert)	34	42.27	8.39	106.35	67.65	43.08
7. AV Delayed (Overt)	29	44.14	9.93	117.79	72.69	41.64
8. AV Delayed (Covert)	33	40.76	10.80	105.67	67.79	41.54

	df	SS	MS	F	Prob.
Feedback	1	88.07	88.07	1.80	--
Response	1	1.72	1.72	0.04	--
Interaction	1	.60	.60	0.01	--
Within	124	6079.13	49.02		

TABLE 8

FEEDBACK WITH AND WITHOUT CORRECT ANSWERS SHOWN
(ANALYSIS OF COVARIANCE)
(Covariates: Non-Language IQ and Vocabulary)

	N	Criterion $\overline{X}$	Criterion σ	Covariate $\overline{X}$ Non-Lang. IQ	Covariate $\overline{X}$ Vocab.	Adjusted Criterion $\overline{X}$
1. Feedback With Answer	34	42.91	12.90	105.03	68.35	45.19
13. Feedback Without Answer	35	46.86	9.81	112.11	74.89	44.65

	df	SS	MS	F	Prob.
Feedback With and Without Answer	1	4.81	4.81	0.10	—
Within	65	3083.63	47.44		

conventional film treatment. The results of the analysis are given in Table 9.

Although the differences among the four treatment versions were not statistically significant, the Massed Audiovisual Review mode was the least effective, and the basic Expository No Response film showed a small superiority over all review modes.

As was the case with the active response and feedback variables, the review variable had no effect upon increasing learning from the experimental film. However, there again appeared to be a slight advantage to spacing the review rather than massing it at the end of the film.

Film vs No Film

A final one-way analysis of covariance was performed to determine whether or not learning had resulted from exposure to the experimental films. The test performance of the Expository No Response group was compared with that of the Control group that took the performance test but did not see any of the films. The results of this analysis are given in Table 10.

TABLE 9

REVIEW AND NO REVIEW (ANALYSIS OF COVARIANCE)
(Covariates: Non-Language IQ and Vocabulary)

		Criterion		Covariate $\bar{X}$		Adjusted Criterion $\bar{X}$
	N	$\bar{X}$	σ	Non-Lang. IQ	Vocab.	
9. Expository No Response	30	43.57	11.17	104.43	72.13	41.50
10. Audiovisual	32	42.00	9.94	101.47	72.22	40.30
11. Audio Only	35	38.97	10.82	102.31	66.54	40.10
12. Massed Audio-visual	30	35.80	13.03	104.93	63.07	38.36

	df	SS	MS	F	Prob.
Review vs No Review	3	138.48	46.16	0.95	—
Within	121	5869.41	48.51		

TABLE 10

FILM AND NO FILM (ANALYSIS OF COVARIANCE)
(Covariates: Non-Language IQ and Vocabulary)

		Criterion		Covariate $\bar{X}$		Adjusted Criterion $\bar{X}$
	N	$\bar{X}$	σ	Non-Lang. IQ	Vocab.	
9. Expository No Response	30	43.57	11.17	104.43	72.13	42.65
14. Control Group	33	26.64	7.92	106.30	66.64	27.82

	df	SS	MS	F	Prob.
Film and No Film	1	3194.01	3194.01	71.93	< .001
Within	59	2619.77	44.40		

The film group showed a superior performance over the Control group significant at greater than the .001 level. Thus, it could be concluded that the experimental films were making a significant contribution to the learning of the content.

Analysis by Learner Characteristics

Analyses were made of two learner characteristics in order to determine whether or not there was a learning differential in the way different types of learners responded to the different experimental treatments. The learner characteristics selected for analysis were the two covariates: Non-Language IQ and Vocabulary ability. The experimental population was split into High IQ (IQ $\geq$ 101) and Low IQ (IQ $\leq$ 100) and into High Vocabulary (above the mean) and Low Vocabulary (below the mean). The same comparisons made in the main analysis were made for each of these split groups, with Vocabulary achievement used as the covariate with the IQ analyses and Non-Language IQ used as the covariate with the Vocabulary analyses. The unadjusted mean scores and standard deviations for these split groups are given in Table 11.

Non-Language IQ

The results of the one-way and two-way analyses of covariance comparing post-test performance for the High and Low IQ groups are summarized in Table 12. The only statistically significant finding was for the expected superiority of the Expository No-Response film over the Control group, but this difference was found for both the High and Low IQ groups.

It may be concluded that none of the experimental treatment conditions interacted differentially with the IQ of the learners.

Vocabulary Achievement

The results of the one-way and two-way analyses of covariance comparing post-test performance for the High and Low Vocabulary achievement groups are summarized in Table 13. As with the total groups and the High-Low IQ groups, the High and Low Vocabulary achievement groups receiving the Expository No-Response film treatment demonstrated significantly superior performance to the Control groups. In addition, several other significant differences between High and Low Vocabulary groups were obtained. In the High Vocabulary group, but not in the Low group, the overt response mode interacted significantly with the audiovisual feedback mode and the covert response mode with the audio feedback mode to increase the learning. The Low Vocabulary group appeared to profit from either audio or delayed feedback after making overt responses. Having no feedback after a covert response was a definite handicap to learning for this group as was the receiving of review information at the end of the film rather than spaced throughout. For

TABLE 11

TOTAL PERFORMANCE POST-TEST MEAN SCORES AND STANDARD DEVIATION FOR HIGH AND LOW NON-LANGUAGE AND VOCABULARY ACHIEVEMENT GROUPS

	Non-Language IQ						Vocabulary Achievement					
	High			Low			High			Low		
Treatment Groups	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ
1. Overt/AV Feedback	20	49.55	9.08	14	33.43	11.72	17	52.59	7.36	17	33.24	9.50
2. Covert/AV Feedback	16	47.38	8.24	18	37.72	5.51	17	47.41	8.16	17	37.12	4.73
3. Overt/Audio Feedback	22	48.23	5.65	13	35.85	8.36	19	48.63	5.55	16	37.69	8.81
4. Covert/Audio Feedback	22	49.64	5.78	14	37.07	10.74	19	50.53	5.34	17	38.29	10.30
5. Overt/No Feedback	19	45.10	7.36	12	36.08	12.31	15	47.80	6.58	16	35.81	10.07
6. Covert/No Feedback	13	43.92	11.69	16	33.25	11.99	14	48.28	7.70	15	28.47	8.43
7. Overt/Delayed Feedback	16	45.81	10.13	13	42.08	9.66	15	48.87	7.27	14	39.07	10.10
8. Covert/Delayed Feedback	21	45.57	9.66	12	32.33	6.93	16	45.00	12.11	17	36.76	7.81
9. Expository No Response	15	50.87	9.23	15	36.27	7.69	13	51.77	7.81	17	37.29	9.16
10. AV Review	22	45.14	10.10	10	35.10	5.02	12	45.33	9.16	20	40.00	10.06
11. Audio Review	20	43.55	10.12	15	32.87	8.68	17	47.59	6.04	18	30.83	7.43
12. Delayed Massed Review	15	41.60	10.54	15	30.00	12.99	14	47.28	4.83	16	25.75	8.80
13. Overt/AV Feedback Without Correction	19	51.05	6.35	16	41.88	11.00	15	53.73	5.99	20	41.70	8.97
14. Control	20	30.20	6.77	13	21.15	6.41	19	29.74	6.72	14	22.43	7.68

TABLE 12

RESULTS OF ANALYSIS OF COVARIANCE
HIGH AND LOW NON-LANGUAGE IQ
(Covariate: Vocabulary)

ANALYSES	High IQ			Low IQ		
	df	F	Prob.	df	F	Prob.
Response vs Feedback (1x3x5x7) x (2x4x6x8)						
Response	1/140	0.07	--	1/103	0.48	--
Feedback	3/140	1.67	--	3/103	0.71	--
Interaction	3/140	0.33	--	3/103	1.26	--
Overt vs No-Response (1x3x5x7x9)	4/86	0.95	--	4/61	0.71	--
Covert vs No-Response (2x4x6x8x9)	4/81	0.60	--	4/69	1.15	--
Immediate Feedback vs Response (1x3) x (2x4)						
Response	1/75	0.00	--	1/54	1.11	--
Immediate Feedback	1/75	0.03	--	1/54	1.06	--
Interaction	1/75	0.98	--	1/54	0.05	--
Immediate and Delayed Feedback vs Response (1x7) x (2x8)						
Response	1/68	0.01	--	1/52	0.77	--
Feedback	1/68	1.51	--	1/52	0.01	--
Interaction	1/68	0.58	--	1/52	3.28	< .10
Feedback With and Without Correct Answers (1x13)	3/67	0.06	--	1/27	0.12	--
Review and No Review (9x10x11x12)	1/36	0.67	--	3/50	0.30	--
Film and No Film (9x14)	1/32	54.02	< .001	1/25	20.86	< .001

TABLE 13

RESULTS OF ANALYSIS OF COVARIANCE
HIGH AND LOW VOCABULARY ACHIEVEMENT
(Covariate: Non-Language IQ)

ANALYSES	High IQ			Low IQ		
	df	F	Prob.	df	F	Prob.
Response vs Feedback (1x3x5x7) x (2x4x6x8)						
Response	1/123	0.86	--	1/120	0.19	--
Feedback	3/123	1.64	--	3/120	4.19	< .01
Interaction	3/123	1.97	--	3/120	2.31	< .10
Overt vs No-Response (1x3x5x7x9)	4/73	2.04	--	4/74	0.95	--
Covert vs No-Response (2x4x6x8x9)	4/73	1.55	--	4/77	5.11	< .01
Immediate Feedback vs Response (1x3) x (2x4)						
Response	1/67	0.87	--	1/62	1.24	--
Immediate Feedback	1/67	0.05	--	1/62	2.71	--
Interaction	1/67	8.19	< .01	1/62	0.59	--
Immediate and Delayed Feedback vs Response (1x7) x (2x8)						
Response	1/60	3.45	--	1/60	0.74	--
Feedback	1/60	2.36	--	1/60	0.50	--
Interaction	1/60	0.34	--	1/60	1.05	--
Feedback With and Without Correct Answers (1x13)	1/29	0.08	--	1/34	5.35	< .05
Review and No Review (9x10x11x12)	3/51	1.12	--	3/66	10.54	< .001
Film and No Film (9x14)	1/29	82.84	< .001	1/28	29.70	< .001

this group, review by sound only was less effective than review by the audiovisual mode, and they found that their performance was increase if they did not see the correct answer projected on the screen after the feedback sequence.

It may be concluded that the Low Vocabulary group reacted more differentially to the stimulus modes than did the High Vocabulary group. Its performance was adversely affected by receiving no feedback of knowledge of correct response after making covert responses and b audio review only. However, it gained from audio or delayed feedbac and from the omission of the correct answer for comparing their responses after audiovisual feedback.

Analysis of Performance Subtests

The performance post-test consisted of items that tested Knowledge, Comprehension, or Application as defined by Bloom (1956). Although these items were distributed throughout the test, when separately analyzed they comprised the subtests, unadjusted scores of which are reported in Table 2 for each treatment group.

The pattern of performance on the three subtests was similar to that on the total performance test. These results are presented in Table 14. Only on the Application subtest were there significant differences in performance, and these tended to be in the same direction as on the other subtests. The no feedback condition was found to be significantly less effective than immediate feedback of knowledge of correct response. Audiovisual immediate feedback interacted positive with overt response and audio immediate and massed delayed feedback with covert response. As with the other analyses, the Expository No-Response film treatment was significantly more effective than no film at all, except that, in the case of the Application subtest items, this difference was significant at only the .05 level, suggesting tha the Application subtest items depended less on the film presentations for information than did the Knowledge and Comprehension subtest item.

In summary, there appeared to be little difference in the pattern of performance among the three subtests or the total test, with the exception of some differences for the Application subtest.

Analysis of Subtest Items Practiced and Not Practiced in the Workbook

The performance post-test consisted of the 19 items that were specifically practiced in the workbook by those treatment groups maki overt or covert participative responses and of the 48 items that were not specifically practiced. Although these items were distributed throughout the test, when separately analyzed they comprised the two subtests.

TABLE 14

RESULTS OF ANALYSIS OF COVARIANCE SUBTESTS: KNOWLEDGE, COMPREHENSION, APPLICATION
(Covariates: Non-Language IQ and Vocabulary)

		Knowledge		Comprehen.		Applicat.	
ANALYSES	df	F	Prob.	F	Prob.	F	Prob.
Response vs Feedback (1x3x5x7) x (2x4x6x8)							
Response	1/251	0.02	--	0.94	--	0.29	--
Feedback	3/251	1.87	--	1.91	--	3.47	<.05
Interaction	3/251	0.65	--	1.30	--	2.26	<.10
Overt vs No-Response (1x3x5x7x9)	4/152	0.30	--	0.44	--	2.29	<.10
Covert vs No-Response (2x4x6x8x9)	4/155	1.99	--	1.82	--	2.61	<.05
Immediate Feedback vs Response (1x3) x (2x4)							
Response	1/133	1.43	--	0.06	--	0.01	--
Immediate Feedback	1/133	0.84	--	0.10	--	0.08	--
Interaction	1/133	0.01	--	0.92	--	6.48	<.05
Immediate and Delayed Feedback vs Response (1x7) x (2x8)							
Response	1/124	0.06	--	0.31	--	0.22	--
Feedback	1/124	0.31	--	2.40	--	2.71	--
Interaction	1/124	0.66	--	0.00	--	4.26	<.05
Feedback With and Without Correct Answers (1x13)	1/65	0.15	--	1.98	--	0.00	--
Review and No Review (9x10x11x12)	3/121	0.57	--	0.68	--	0.81	--
Film and No Film (9x14)	1/59	124.40	<.001	30.00	<.001	5.41	<.05

The results, presented in Table 15, show only one significant difference in performance--that for the interaction between immediate audiovisual and audio feedback and overt or covert response for the unpracticed items. This advantage was to the treatment group that combined covert response with audio feedback. Although not significant, the practiced items, in this comparison, were most effectively learned when overt response was combined with audio feedback. With this one exception, all treatment groups appeared to perform as well on the non-practiced items as on the practiced items.

A separate analysis, presented in Table 16, compared the performance on the subtest items practiced and not practiced in the workbook in terms of percent answered correctly for the nine workbook groups and the four non-workbook groups. Although the workbook groups answered 12.4% more of the practiced items than the non-practiced items, the non-workbook groups (which had no workbook practice on any of the items) also answered 10.6% more of the practiced than the non-practiced items. This represented an insignificant difference of only 1.8% items correctly answered between the practice and non-practice groups. There appeared, however, to be a small overall advantage for the Workbook groups over the Non-Workbook groups--5.4% on the Practiced items and 3.6% on the Non-Practiced items.

It may be concluded that the test items previously practiced in the workbook, correct answers to which were then fed back to the learner, were not learned appreciably better than those test items that rereceived no workbook practice.

Qualitative Analyses

Measures were made of the state of mind of the subjects as they experienced the experimental situation. The semantic differential scale, a student reaction scale, and open-ended questions were used to probe feelings about the stimulus.

Semantic Differential

The semantic differential instrument (see Appendix D), consisting of eleven 7-point scales, was administered about two weeks following the administration of the stimulus film treatments. The concept, "The Story You Saw About the Eco-System," was rated on each of the scales. Since the purpose of the analysis was comparison among treatment groups, t-tests were computed to establish the order of differences between means for each group. Differences found to be significant at the .05 level or less are presented in Table 17. The means for the groups and items referenced are presented in Table 18. The tables may be used together. For example, it was found that treatment groups 1 and 2 differed significantly at the .05 level on item 7 of the scale (REPETITIVE/VARIED). Their means were 4.34 and 3.43; that

TABLE 15

RESULTS OF ANALYSIS OF COVARIANCE SUBTEST ITEMS PRACTICED AND NOT PRACTICED IN THE WORKBOOK
(Covariates: Non-Language IQ and Vocabulary)

		Practiced (19 items)			Not Practiced (48 items)	
ANALYSES	df	F	Prob.	df	F	Prob.
Response vs Feedback (1x3x5x7) x (2x4x6x8)						
Response	1/224	0.81	--	1/224	0.21	--
Feedback	3/224	1.34	--	3/224	1.97	--
Interaction	1/224	1.57	--	1/224	1.37	--
Overt vs No-Response (1x3x5x7x9)	4/140	1.07	--	4/140	0.96	--
Covert vs No-Response (2x4x6x8x9)	4/136	2.27	< .10	4/136	1.88	--
Immediate Feedback vs Response (1x3) x (2x4)						
Response	1/120	0.14	--	1/120	1.51	--
Immediate Feedback	1/120	0.58	--	1/120	0.00	--
Interaction	1/120	1.63	--	1/120	4.46	< .05
Immediate and Delayed Feedback vs Response (1x7) x (2x8)						
Response	1/110	0.23	--	1/110	0.11	--
Feedback	1/110	0.03	--	1/110	0.31	--
Interaction	1/110	0.94	--	1/110	0.07	--
Feedback With and Without Correct Answers (1x13)	1/62	0.21	--	1/62	0.04	--
Review and No Review (9x10x11x12)	3/106	0.29	--	3/106	0.92	--

TABLE 16

PERCENT OF PRACTICED AND NON-PRACTICED SUBTEST ITEMS ANSWERED CORRECTLY BY WORKBOOK AND NON-WORKBOOK GROUPS

	Practiced Items %	Non-Practiced Items %	Difference %
Workbook Groups (1,2,3,4,5,6,7,8,13)	73.1	60.7	12.4
Non-Workbook Groups (9,10,11,12)	67.7	57.1	10.6
Difference	5.4	3.6	1.8

TABLE 17

SIGNIFICANCE OF DIFFERENCE BETWEEN GROUP MEANS ON ITEMS IN THE SEMANTIC DIFFERENTIAL

EXPERIMENTAL FILM GROUP	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Overt/AV Feedback		7/.05* 11/.05	-4/.05			11/.05	11/.01	3/.05 7/.05		7/.05	11/.05		2/.05
2. Covert/AV Feedback									-7/.05		4/.05		
3. Overt/Audio Feedback					4/.01 10/.05	4/.01	4/.05		4/.01	4/.01 8/.01	4/.01	4/.01	4/.05
4. Covert/Audio Feedback					4/.05				9/.05	8/.05	4/.01		
5. Overt/No Feedback								1/.05					2/.05
6. Covert/No Feedback										8/.05			
7. Overt/Delayed Feedback										8/.05		11/.05	
8. Covert/Delayed Feedback									-2/.05	-3/.05	4/.05		
9. Expository No Response													2/.05
10. AV Review													-8/.01
11. Audio Review													
12. Delayed Massed Review													
13. Overt/AV Feedback Without Correction													

*First figure presented is the item number; second is level of significance determined by t-test. Read group to left first, then group on top. If sign for the item number is negative, read top group first.

TABLE 18

GROUP MEANS FOR ITEMS IN THE SEMANTIC DIFFERENTIAL
(Center of Scale = 4)

GROUPS \ ITEMS	1	2	3	4	5	6	7	8	9	10	11
1	2.71	3.26	5.16	4.58	3.08	2.92	4.34	4.13	3.90	3.57	4.46
2	2.43	3.06	4.60	4.80	3.40	3.21	3.43	4.09	3.74	3.26	3.77
3	2.76	3.00	4.92	5.37	3.08	3.51	3.79	4.49	3.84	3.68	3.97
4	2.72	2.92	4.97	5.00	2.94	3.17	3.94	4.51	3.97	3.56	3.91
5	2.25	2.19	4.87	4.10	3.19	2.65	4.10	4.26	3.81	2.74	4.13
6	2.85	2.88	4.73	4.48	3.15	3.36	4.18	4.39	3.65	3.21	3.70
7	2.73	3.23	4.76	4.50	3.35	2.88	3.91	4.38	3.74	3.44	3.59
8	3.00	2.66	4.41	4.80	3.52	3.42	3.45	3.97	3.87	3.74	4.00
9	2.69	3.29	4.79	4.40	3.03	3.09	4.42	4.15	3.32	3.41	4.09
10	2.69	3.10	5.14	4.38	3.31	2.69	3.45	3.72	3.86	2.97	4.00
11	2.58	2.82	4.94	4.00	3.21	3.00	3.88	4.18	3.72	2.94	3.75
12	2.56	3.00	4.81	4.44	3.03	2.97	4.06	4.28	3.72	3.25	4.16
13	2.50	2.64	4.97	4.63	3.31	2.72	4.11	4.42	3.67	3.47	4.00

is, group 1 found the stimulus films significantly more varied than did group 2. Inasmuch as the scalar center is 4, group 2 thought the film was slightly repetitious, and group 1 found it slightly varied.

In general, all of the film treatments were perceived to be GOOD, WORK, KIND, SLOW, STRONG, PLEASANT, MASCULINE, and LOUD. The largest number of significant differences between treatment groups (thirteen differences) was for the FAST/SLOW dimension of the scale, with the Overt Response/Audio Feedback group (#3) finding the film to be significantly "slower" than eight of the remaining twelve treatments. On the other hand, the Audio Review group (#11) perceived their film to be significantly "faster" than four of the other groups. The Audiovisual Review group (#10) found their film to be more "feminine" than five of the other groups, the only treatment group that interacted significantly on the FEMININE/MASCULINE dimension of the scale.

The two treatment groups utilizing overt response--Film Treatment 1 with audiovisual feedback and Film Treatment 3 with audio feedback--each showed ten significant differences with other treatments, the largest number for any of the film treatment groups. The Overt Response Audiovisual/Feedback group (#1) perceived their film to be more "varied" than three of the other groups and "lighter" than four of the other groups. The Overt Response/Audio Feedback group (#3) perceived their film to be significantly "slower" than eight of the other treatments.

Student Reaction Scale

A student reaction scale, consisting of five 5-point scales (see Appendix D), was administered at the same time as the semantic differential scale about two weeks following the administration of the stimulus film treatments. The purpose of the scale was to elicit ratings relative to the subjects' perceptions of the length of the film, liking for the film, learning from the film, test difficulty, and helpfulness of the workbook in learning the material. Since the purpose of the analysis was comparison among treatment groups, t-tests were computed to establish the order of differences between means for each group. Differences found to be significant at the .05 level or less are presented in Table 19. The means for the groups and the questions asked are presented in Table 20. The tables may be used together.

In general, there was a tendency for all the treatment groups to rank the film treatments close to the mean. They considered that the film treatments were a little long; they liked them somewhat; they thought they learned something from them; they thought the test was fairly easy; and they felt the workbook helped them somewhat in learning the material.

The largest number of significant differences between treatment groups was for the Overt Response/Audiovisual Feedback group (#1), this

TABLE 19

SIGNIFICANCE OF DIFFERENCES BETWEEN GROUP MEANS ON QUESTIONS IN STUDENT REACTION SCALES

EXPERIMENTAL FILM GROUP	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Overt/AV Feedback		1/.05*	1/.05 -5/.05	1/.02	1/.05 -5/.02	1/.05	1/.05	1/.05			1/.05	2/.05 4/.05	
2. Covert/AV Feedback										-1/.02			
3. Overt/Audio Feedback									5/.05	-1/.01		2/.05	
4. Covert/Audio Feedback										-1/.01			
5. Overt/No Feedback									5/.05	-1/.02		4/.05	
6. Covert/No Feedback										-1/.02		2/.05	
7. Overt/Delayed Feedback										-1/.02			
8. Covert/Delayed Feedback										-1/.02		2/.01	
9. Expository No Response												4/.05	
10. AV Review											-1/.02		
11. Audio Review													
12. Delayed Masses Review													
13. Overt/AV Feedback Without Correction													

*First figure presented is the item number; second is level of significance determined by t-test. Read group to left first, then group on top. If sign for the item number is negative, read top group first.

TABLE 20

GROUP MEANS FOR QUESTIONS IN STUDENT REACTION SCALES
(Center of Scale = 3)

	Length of Film (Very long to very short)	Liking for Film (Liked a lot to disliked a lot)	Learning from Film (Very little to great deal)	Difficulty of Test (Very easy to very hard)	Helpfulness of Workbook (Not at all to a great deal)
1. Overt/AV Feedback	2.74	2.55	3.46	2.40	3.00
2. Covert/AV Feedback	2.41	2.38	3.56	2.53	3.32
3. Overt/Audio Feedback	2.30	2.58	3.55	2.71	3.48
4. Covert/Audio Feedback	2.34	2.50	3.69	2.50	3.24
5. Overt/No Feedback	2.33	2.21	3.57	2.39	3.68
6. Covert/No Feedback	2.39	2.55	3.52	2.71	3.07
7. Overt/Delayed Feedback	2.38	2.44	3.55	2.71	3.32
8. Covert/Delayed Feedback	2.33	2.73	3.52	2.60	3.35
9. Expository No Response	2.46	2.39	3.29	2.39	2.71
10. AV Review	2.91	2.46	3.10	2.68	3.17
11. Audio Review	2.33	2.33	3.67	2.70	3.08
12. Delayed Massed Review	2.53	2.06	3.59	2.78	3.33
13. Overt/AV Feedback Without Correction	2.56	2.06	3.67	2.78	3.41

group considering the film significantly "shorter" than eight of the other groups. The Audiovisual Review group (#10) also considered the film "shorter" than seven of the other groups, but the Audio Review group (#11) perceived it as significantly "longer" than two of the other groups. The Delayed Massed Review group (#12) "liked" the film significantly better than four of the other groups, but thought the test was "harder" than did three of the groups. The Overt Response/Audiovisual Feedback group (#1) felt that the workbook was more "helpful" in assisting them to learn. There were no significant differences between any of the groups in their assessment of their level of "learning" from the film.

Open-Ended Questions

Three open-ended questions were asked on the same form containing the student reaction scale (see Appendix D). These responses were obtained about two weeks following the administration of the stimulus film treatments.

To the question, "Which part did you like best?" most groups were about equal in their responses. The most frequently given answers related to the curious living habits of fish.

To the question, "Which part did you like least?" again the groups were about equal in their responses. There were frequent mentions of "the workbook" and "stopping the film" in response to this question. A number of subjects also responded "what fish eat" or its equivalent, thus confusing the rather clear-cut preference for knowing about the curious habits of fish.

To the question, "Did you have any trouble understanding it?" 330 subjects stated they had no trouble understanding, and 76 said they did have trouble.

CHAPTER IV

CONCLUSIONS, DISCUSSION, AND IMPLICATIONS

This chapter will present the specific conclusions that may be derived from the data, discuss the results of the study, and suggest implications of the study for the design of instructional media.

Conclusions

The following conclusions may be made from an analysis of the results of the study.

A. Response and Feedback Variables:

1. The feedback to learners of knowledge of results of the correctness of their responses to workbook questions answered during the showing of a general science film was found to significantly increase learning over a condition where no feedback was given. This superiority was found for knowledge of results given in either an audiovisual or an audio-only feedback mode and when given either immediately after the student response or when delayed until the end of the film.

2. When no feedback was given to learners regarding the correctness of their responses under the "covert" response conditions, significantly inferior performance resulted. There were no significant differences in such learning, however, under the "overt" response conditions.

3. Neither "overt" responses nor "covert" responses were found to be superior to the other under any of the feedback conditions.

4. There appeared to be a slight, but statistically insignificant, advantage for "immediate" audiovisual feedback of knowledge of results over "delayed" feedback massed at the end of the film under both response conditions.

B. Review Variables:

1. There were no significant differences among the three modes of presenting the review sequences. However, the "massed" audiovisual review mode was the least effective, suggesting some slight advantage to spacing the review rather than massing it at the end of the film.

C. Conventional Expository Treatment:

1. The Expository No Response film treatment, in which no active student responses were made, no feedback given, and which took one-half the time to present, was as effective as any of the other experimental treatments.

2. The Expository No Response film treatment resulted in greatly superior performance over the Control group which saw none of the film treatments. Thus, it could be concluded that the experiment films were making a significant contribution to the learning of the content.

D. Learner Characteristics:

1. Although the higher mental ability students performed at significantly higher level than the lower mental ability students, neither of these groups interacted differentially with the experiment variables studied.

2. Those students with higher vocabulary achievement perform at a significantly higher level than those with lower vocabulary achievement, but the lower group interacted more differentially to th stimulus modes. The performance of the low group was adversely affected by receiving no feedback of correct knowledge of results after making covert responses and by the audio or delayed review. It profid from audio or delayed feedback after making overt responses and from the omission of the correct answer for comparing their responses afte audiovisual feedback.

E. Performance on Subtests:

1. The patterns of performance on the Knowledge and Comprehe-sion subtest items were similar to that on the total performance test However, on the Application subtest, the "no feedback" condition was found to be significantly less effective than "immediate feedback" o knowledge of results. Also "audiovisual immediate feedback" interact positively with "overt response" and "audio immediate feedback" and "massed delayed feedback" with "covert" response.

2. Test items previously practiced in the workbook, correct answers to which were then fed back to the learner, were not learned appreciably better than those test items that received no workbook practice.

F. Qualitative Reactions:

1. On the semantic differential scale all of the treatment group made generally positive reactions to material presented. No o-standing qualitative advantage could be discerned for any particular experimental treatment.

2. On a student reaction scale there was a general tendency for all the treatment groups to rank the experimental treatments close to the mean. The students considered the films to be a little long; but they liked them somewhat, thought they learned something from them, thought the performance test was fairly easy, and felt the workbook helped them somewhat in learning the material.

3. The open-ended questions revealed no useful information from student opinions.

Discussion

Several results of the study warrant a more detailed discussion. In this section, those specific outcomes that appear to have implications for the design of instructional materials will be examined.

General Effects of the Experimental Variables

Contrary to expectations, the inclusion of various procedures for eliciting student response, providing feedback of knowledge of the correctness of these responses, or presenting review sequences in an instructional general science film appeared to have minimal measurable effects upon the learning of the content. The film version (Expository No Response treatment), produced in the conventional way without these design elements, resulted in as much learning and in about half the time. Previous research with response, feedback, and review variables (Allen, 1960; Lumsdaine, 1963) strongly indicated that these techniques should have resulted in improved performance. Why did the results of this study contradict the earlier findings? There are four possible explanations.

First, the design variables (response, feedback, review), as employed in this experiment, may, in fact, have exerted no measurable influence on the learning of the content. The nature of the content may have been such that it did not interact with the variables studied. In the light of previous research evidence, this explanation is difficult to accept.

Second, the performance test itself may have been insensitive to the variations in learning produced by the experimental treatments. There is some evidence that the experimental subjects found the test to be easier than the tryout population. Item analyses after the first tryout showed most items to be too difficult, and corrections were made to make them easier. The second tryout confirmed the results of these changes, the group mean being about 50% correct answers. However, the mean for the entire experimental population was about 65% correct answers, this group finding the test much easier. Since the subjects from both the tryout and experimental schools were comparable on measured dimensions, the only change that might account for so large a shift was procedural. During the tryouts, rather complex IBM sense-score sheets were used, necessitating the transfer of answers from the test booklet to the answer sheets. Because the tryout subjects found these sheets difficult and hard to use, a procedure of direct answering in the test booklet itself was utilized with the experimental population. Thus, the procedure used with the tryout groups may have made the test appear to be more difficult. So the performance test may have been a slightly blunted instrument with a ceiling lower than desirable. However, it is felt that this slight insensitivity in the test was not sufficient to account for the failure of the experimental variables to produce increased learning.

Third, the design variables built into the films may have resulted in stimuli that were too long, tedious, and monotonous. During the workbook exercises specified lengths of time were given for the answering of the questions, and all groups conformed to this allocation as a control measure. This procedure served to slow down the presentation of the films for the more able subjects and may have tempered their involvement in the film. That the subjects perceived the films as slow was confirmed in the qualitative measures. However, similar reactions were made by the non-workbook groups, and it is felt that the monotony factor could not account for the failure of the experimental variables to produce increased learning.

Fourth, the design elements that were built into the films, other than the experimental variables, may have resulted in a level of learning beyond which differences were difficult to obtain or to detect. The high level of learning (65% of the maximum possible) achieved by the conventional Expository No Response group tends to confirm this. Looking at the script for this film (Appendix A) it will be seen that considerable repetition and redundancy was built in. An effort was made by the researchers to design as effective a film as possible (excluding the experimental variables). This fact may have resulted in a condition where the response, feedback, and review variables performed an additive function only. Because the basic film had raised the level of achievement about as high as could be expected, these additive features had little opportunity to increase the learning. A post-experimental review of the Expository No Response script shows that the concepts and words tested in the 19 performance test questions practiced in the workbook were repeated a total of 85 times. The concept that marine life has a particular place in which to live and particular needs (Test Questions #3, #16, #66) occurred 14 times either as statements of the concept or as repetitions of the word "needs." The needs themselves (warmth, light, safety, food), which were tested in five different test questions (#10, #62, #63, #64, #65), appeared in the script in 20 separate repetitions. Other practiced items—"system," "eco-system," "plankton"—each appeared in the script seven times. Only two of the practiced items appeared in the script three or fewer times. These repetitions—on precisely those items that the response, feedback and review variables were designed to influence—

may have served to mask out the effects of the experimental variables. Repetition, as has been pointed out in research reviews by Allen (1960) and Lumsdaine (1963), is an important factor in increasing learning. The experimenters, in attempting to design an effective basic film, may have underestimated just how powerful this variable could be. There is no assurance, of course, that this was the cause of the non-significant differences obtained in the study, but it is the most probable one of the four possible explanations.

Response and Feedback

The overall lack of significant differences on learner response variables warrants little discussion other than the comments made in the preceding section. The fact that no differences in performance were found between the "overt" and "covert" response groups is not surprising in the light of the research evidence.

The slight advantage accruing to the groups that used the workbooks, on both the practiced and non-practiced items, suggests that the making of active responses has some positive effect upon learning. The research evidence would indicate, however, that the effects should have been far greater than they were.

It did appear that "covert" response, coupled with the different feedback modes resulted in a more variable performance than did "overt" response. Receiving "no feedback" resulted in a decided disadvantage for the "covert" response group; and it is possible to suggest that when a response is made covertly, it has more need for reinforcement through feedback of the correctness of the response than when the response is made overtly. This supposition may be supported by the results of the analyses of learner characteristics wherein the low vocabulary achievement group performed significantly lower when it responded covertly and received no feedback of knowledge of the correctness of that response.

The only significant finding in the analysis of the effects of the feedback variable was in the general superiority of "immediate" feedback over "no" feedback when the "covert" mode of student response was employed. On the separate subtest analyses, however, it was found that this difference held only for the Application subtest. Apparently, the provision of feedback was more important in the learning of material that required the application of learning than in the comprehension of the material or the recall of facts presented. Evidence from previous research indicated that the feedback variable should have had far greater effect upon performance than it showed in the study.

Review

The failure of the review variable to increase the learning may have been a function of the powerful influence of the repetition built into the basic content of the films as discussed above. In fact, review itself is inherently a type of repetition, and if the repetition has already occurred at a level great enough to establish learning of the concept taught, there should be little expectation of increasing learning through additional repetition.

The superiority of the "immediate and spaced" review over the "massed and delayed" review, although statistically insignificant, was supportive of learning research and contrary to the findings of the Miller and Levine study (1952), which found that massing of review material at the end of a science film was significantly more effective than spacing the review sequences throughout the film.

Learner Characteristics

The tendency for the low achievers in vocabulary to have their performance adversely affected by receiving no feedback of the correctness of their responses after responding covertly seems to be logical. This group might be expected to require more reinforcement of responses made less actively. However, the same expectation might also be expected from the lower mental ability students, and this effect was not observed.

It is difficult to account for the extremely low performance of the low achievers in vocabulary in the Delayed Massed Review group, in which the lower mental ability students also showed the poorest performance. Nor is there any explanation for the high performance of the lower vocabulary group on the Overt Response/Audiovisual Feedback Without Correction treatment (Treatment No. 13). It might be expected that the additional practice (as provided in Treatment No. 1) would benefit this lower ability group.

Implications

The implications of this study for the design of instructional media seem to be more negative than positive. That is, the anticipated effects from the response, feedback, and review variables studied were not obtained. This does not mean, of course, that such variables are not important in the design of instructional media; but that, under the conditions prevailing in this experiment, they did not produce the expected effects.

It may be, as discussed above, that the repetition and redundancy built into the films were sufficiently pervasive to override the effects of the experimental variables. If so, this fact itself has implications for the design of instructional materials. However, the comparative effects of the response/feedback/review variables and the repetition/redundancy variables were not studied in this experiment and would need to be compared under controlled conditions in a future study.

The suggestion that low achievers benefit more from feedback of knowledge of the correctness of their responses has some implications for instructional media design, but this study was unable to draw precise conclusions as to exactly what design elements were appropriate for what learner groups.

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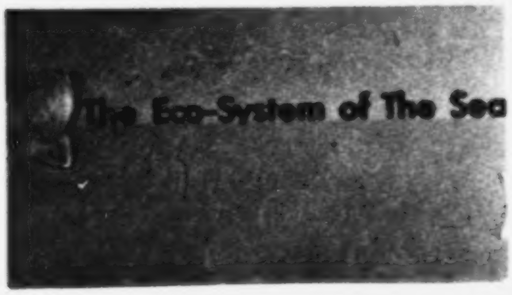
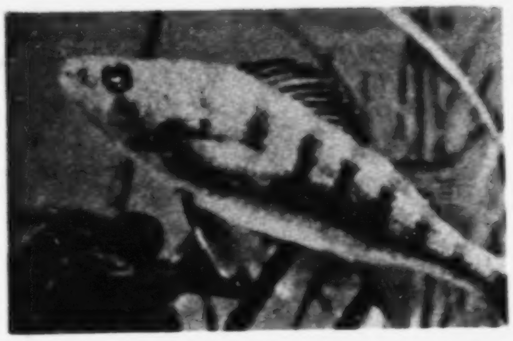
APPENDIX A

SCRIPTS OF EXPERIMENTAL TREATMENTS

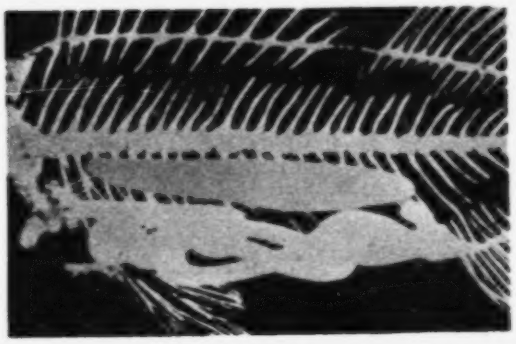
EXPLANATION: The script shown immediately below was for the most elaborate treatment used in the study: the Overt Response with Immediate Audiovisual Feedback and Correct Answer (Film Treatment No. 1). The illustrations show the key points in the film. Those scene numbers marked with an asterisk (*) indicate the places where the other experimental treatments differ from Film No. 1. Following the script for Film No. 1, each of the specific changes made in the other films will be detailed.



1. A fish has an interesting way of moving up and down in the water.



2. It does this by means of its swim bladder ...



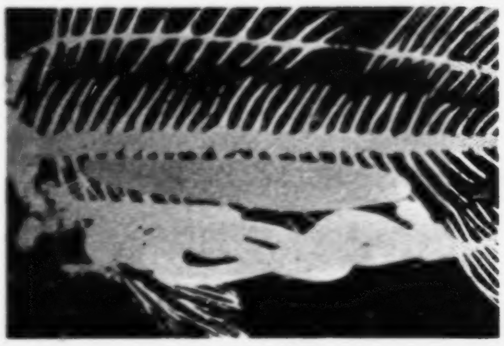
3. ...which, if filled with air, enables it to rise in the water ...

4. ... if partly filled or empty, to sink in the water.

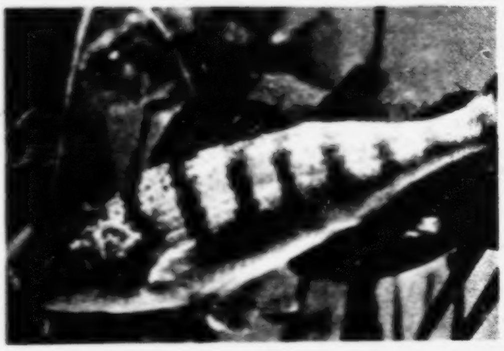
*5. Please turn to page one in your book. Look carefully at the question there. Then answer: Is it True or False? When a fish empties the air from its swim bladder, it will go deeper into the water? Mark an X in your book beside the correct answer: True or False. (10 SECONDS NO SOUND). Now look at the screen and listen to the right answer.

BLANK SCREEN

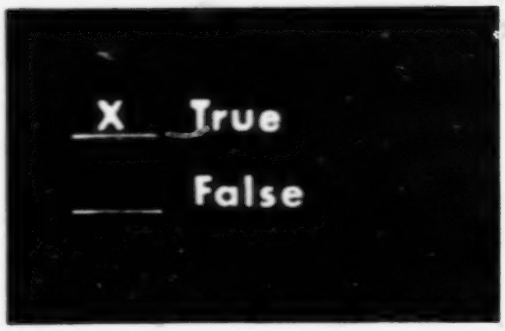
*6. When a fish empties the air from its swim bladder ...



*7. ... it will go deeper into the water.



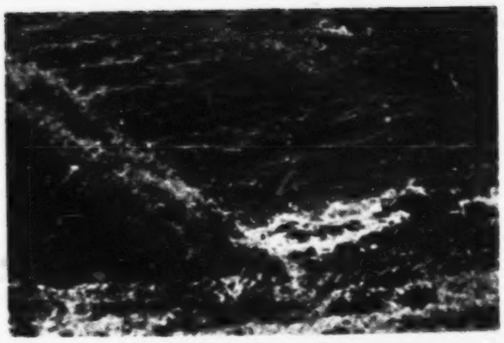
*8. From the answer on the screen, correct page one in your book. The correct answer is True.



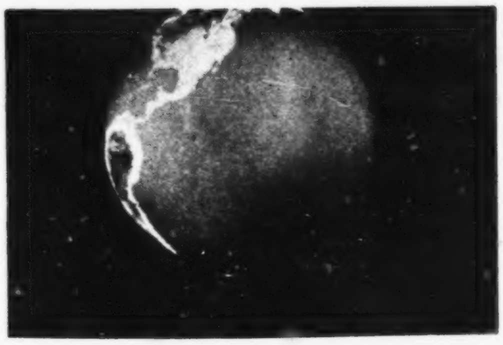
_X_ True

___ False

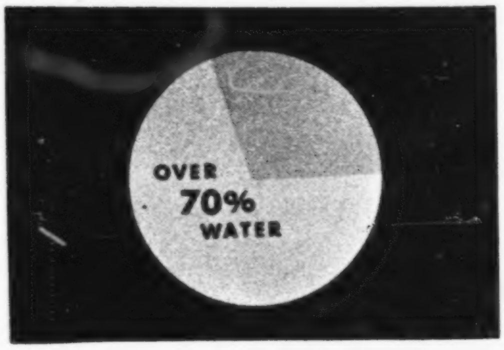
9. This reminds us that ... we live on a planet of lands and of oceans.



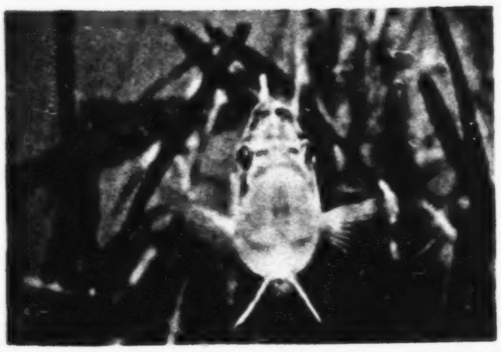
10. Our planet is called the earth ...



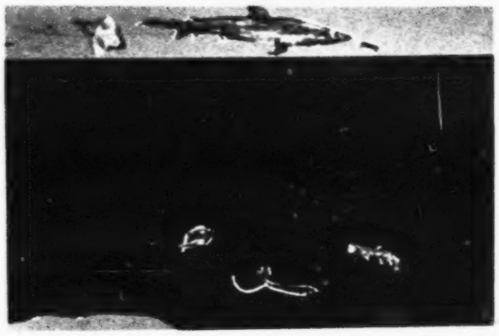
11. ... yet over 70% of its surface is covered by water ... water found in the great oceans of the earth.



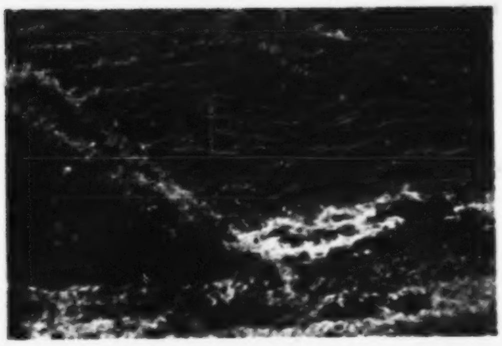
12. In these oceans are many forms of animal life ... and plant life ... animal and plant life that we call marine life because they live in the ocean or sea.



13. There is marine life at all depths of the sea, but each form of marine life has a particular place it usually lives. Some forms live near the brightly lit top ... some deeper down in the dimly lit area ... and others in the very deep dark ocean ... even near the earth on the bottom of the sea. So there is marine life at every depth in the sea.



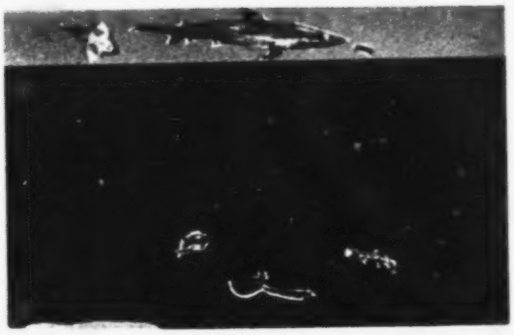
14. Changes in the nature of the sea ... its winds, tides, saltiness and so on ... cause different forms of marine life to live where they live.



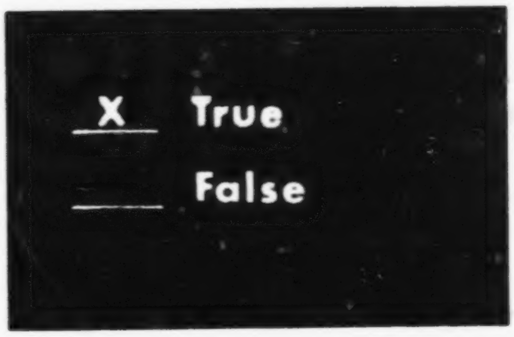
*15. Turn to page two in your book ... Look carefully at the question there, then answer: Is it True or False? Each form of marine life has a particular place in the sea where it usually lives. Mark an X in your book beside the right answer: True or False. (15 SECONDS NO SOUND). Now look at the screen and listen to the right answer.

BLANK SCREEN

*16. Each form of marine life has a particular place where it usually lives.



*17. From the answer on the screen, correct page two of your book. The correct answer is True.



X True

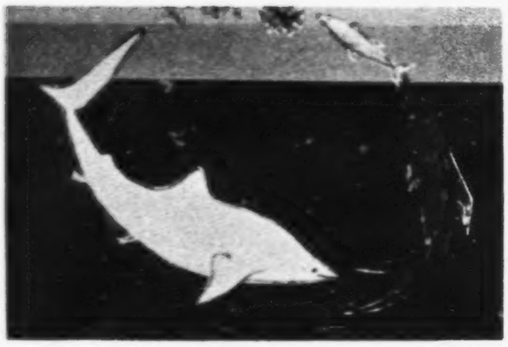
False

18. Also important to where each form of marine life lives are its own special needs. One of these needs is food. Each form of marine life needs its own kind of food.

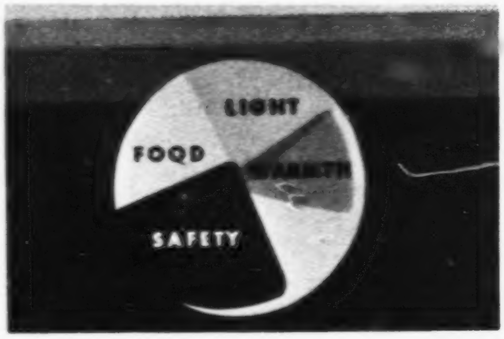
19. And one form of marine life becomes food for another form of marine life.

20. This need for food goes on ... and on ... and on ... throughout the sea.

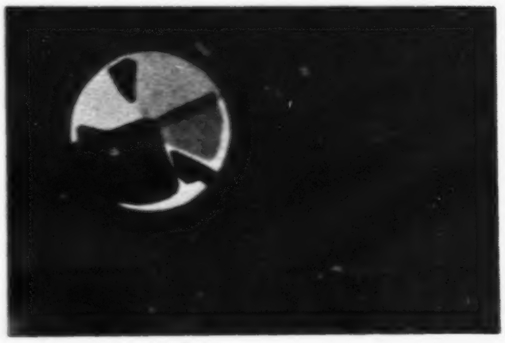
21. The great circle of marine life ... one form feeding on another ... is often called a food-chain. What we see at work here is a system by which every form of marine life finds the food which it needs.



22. Food, then, is a need that makes each form of marine life live where it lives. Marine life has many other important needs: like keeping from getting caught and becoming food itself ... or like getting light enough to see both its food and its enemies ... or like keeping warm enough while moving toward lights, food, or safety. Each form of marine life has many needs--all related to one another, and all parts of one system.



23. Scientists give this system a rather big name: they call it an ecological system.

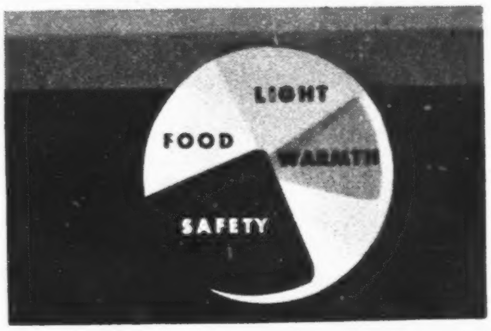


24. But scientists sometimes shorten such big names. Many of them call this system the eco-system of the sea.

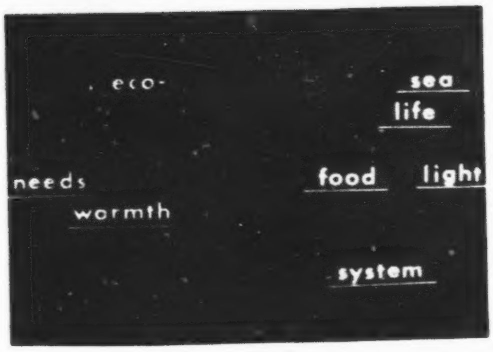
*25. Turn to page three in your book. Look carefully at the question there. Then fill in the right words where there are now blanks. (2 MINUTES NO SOUND). Now look at the screen and listen to the right answer.

BLANK SCREEN

*26. In the eco-system of the sea, different forms of marine life live where they do because of their own needs: like safety, food, light, and warmth. The relationship to one another for such needs for life in the sea is called a system.

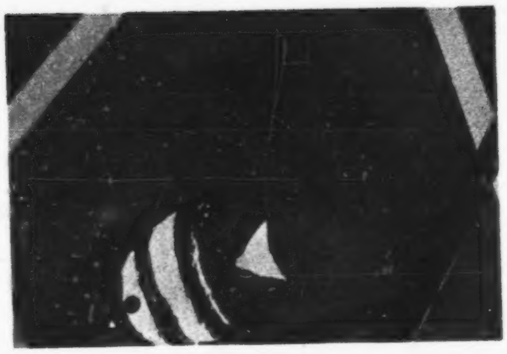


*27. From the answer on the screen, correct page three in your book. The correct answers are: eco or ecological; life or animals; needs; food, light and warmth in any order; and system.

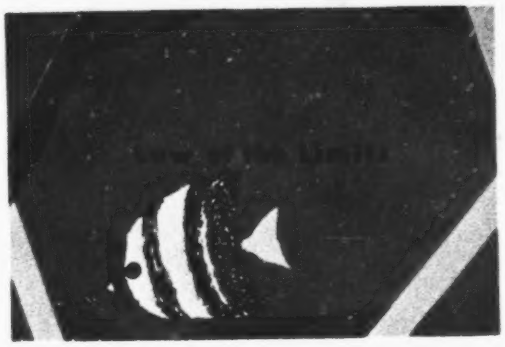

eco-
sea
life
needs
food
light
warmth
system

28. Each form of marine life has its own place to live, its own way of fitting into the eco-system of the sea, its own needs. Because of such needs, each form of marine life seems to have a fence around its usual place to live.

29. A quite imaginary fence ... one which marks the limits, let us say, to which a fish usually will go. By limits we mean the edges of that area within which a fish might find enough food, yet not too much danger ... enough light or darkness, yet not too much warmth or cold ... Not too much, nor yet too little, of whatever it needs.



30. We give a name to what keeps marine life inside such imaginary fences: we call it the Law of the Limits.

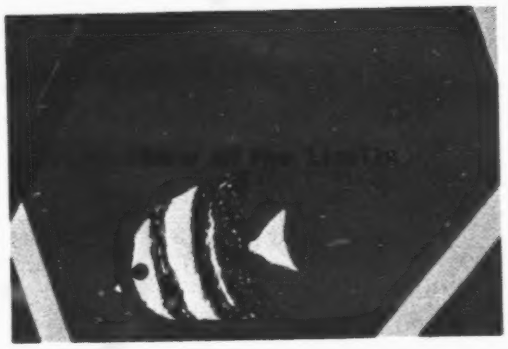


31. If we knew all there is to learn about the Law of the Limits, we would know just where to find each form of marine life in the eco-system of the sea.

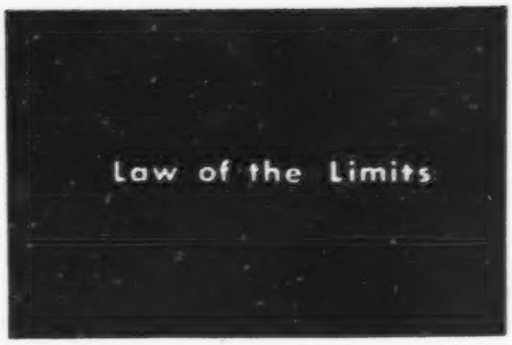
*32 Turn to page four in your book. Look carefully at the question there: What name do w give to what keeps marine life inside imaginary fences in order to stay alive? Write your answer in your book. (40 SECONDS NO SOUND) Now look at the screen and listen to the right answer.

BLANK SCREEN

*33. The Law of the Limits is what we call what it is that keeps marine life inside imaginary fences in order to stay alive.

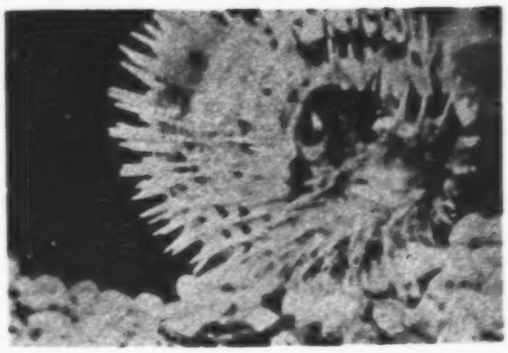


*34. From the answer on the screen, correct page four in your book. The correct answer is the Law of the Limits.

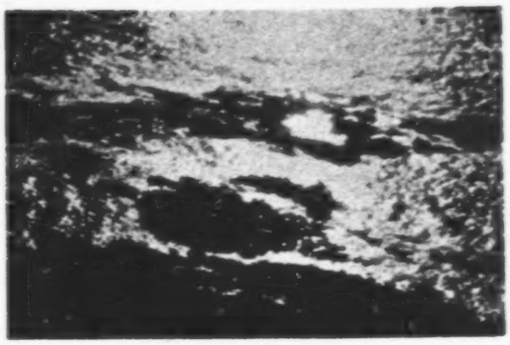


Law of the Limits

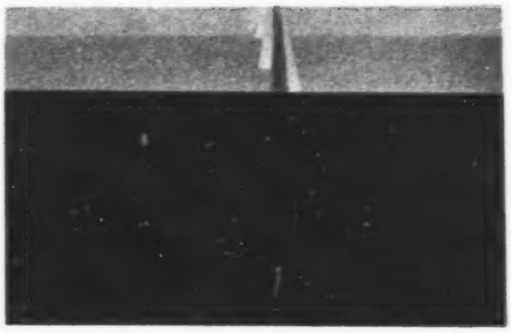
35. We shall learn much more about the eco-system of the sea and its law of the limits if we think about how one need of marine life can relate to all others.



36. Think about light! Most of the light in the sea comes from the sun. But sunlight reaches nowhere near so far through the water as it does through the air.



37. Sunlight comes down in many colorful rays. But the warmer rays of the sun reach down only 250 feet into a sea which is up to seven miles deep. Deeper than these bright rays can reach, the cooler rays light and warm the sea for another few hundred feet. The rest of the sea is quite cold and dark as we go down ... as if in a submarine ... down to the floor of the sea.



*38. Turn to page five in your book. Look carefully at the question there. Imagine you are in a submarine 400 feet down into the sea. If you look out into the sea, what color would the water be? Mark an X in your book beside A, B, or C. (20 SECONDS NO SOUND) Now look at the screen and listen to the right answer.

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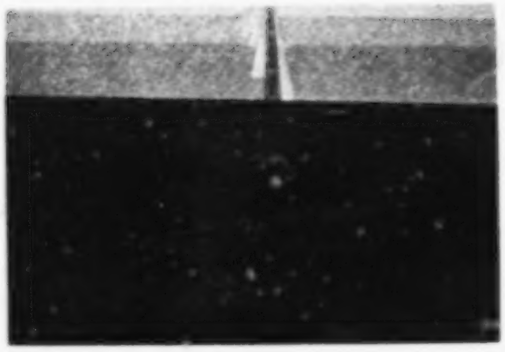
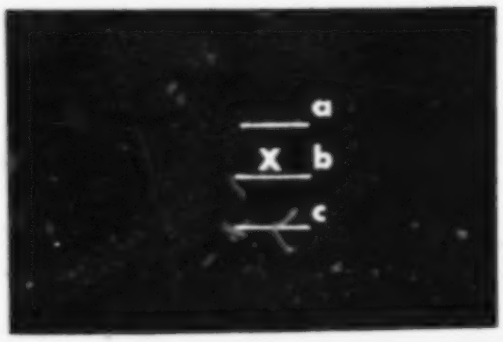
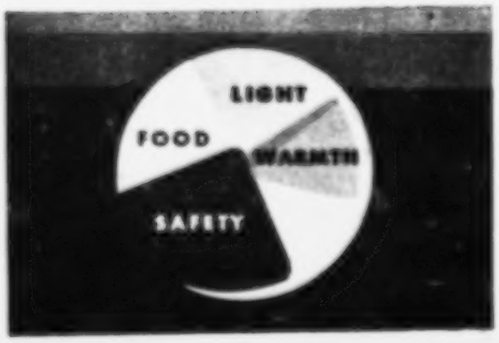
*39. At a depth of 400 feet in the sea ... that is, in the middle area ... the water is colored a dimly lit blue.



*40. From the answer on the screen, correct page five in your book. The correct answer is B.



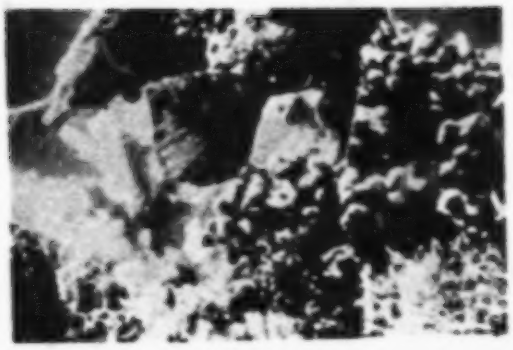
41. Light is related, not only to warmth, but also to safety.



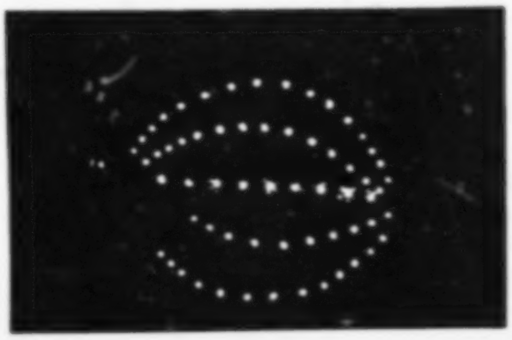
42. Many forms of marine animals are colored in such ways that they blend into their surroundings and are hard for their enemies to see or find.

43. Some blend into the light above ... some blend into the darkness below ...

44. ... and some resemble the places in which they hide.



45. Those in the deep, dark depths of the sea may be able to flash lights of their own, helping them to see or to scare their enemies.



*46. Turn to page six in your book. Look carefully at the question there. List three different ways in which marine animals hide from their enemies. Write your answer in your book. (45 SECONDS NO SOUND) Now look at the screen and listen to the right answers from which you may have chosen three.

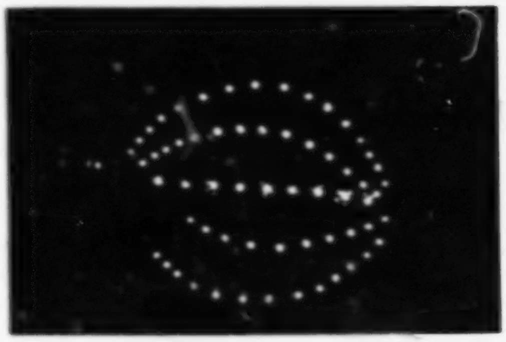
BLANK SCREEN

*47. Some marine animals blend into light above, some into darkness below ...

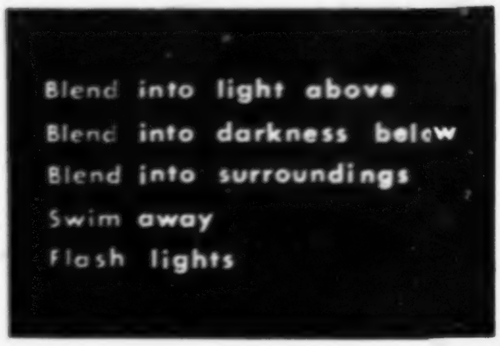
*48. ... some into their immediate surroundings ...

*49. ... some swim quickly away ...

*50. Some flash lights to see or to scare their enemies.

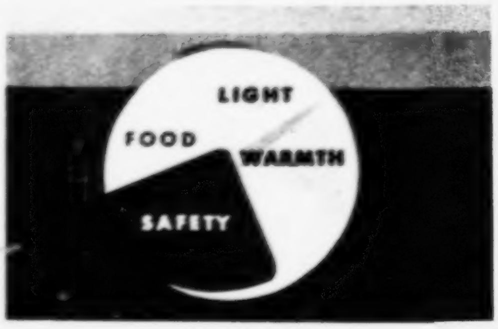


*51. Now correct page six in your book. You may have the answer in any order. A correct answer would be any three of these five: Blend into light above, into darkness below, into surroundings, swim away, flash lights. Now look at the screen.

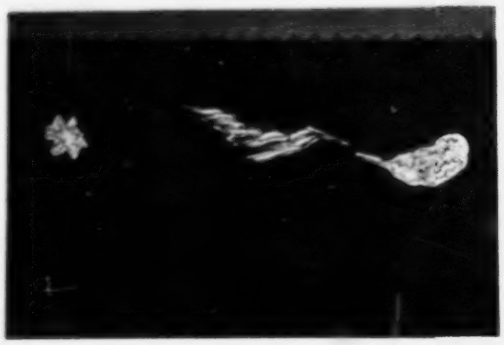


Blend into light above
Blend into darkness below
Blend into surroundings
Swim away
Flash lights

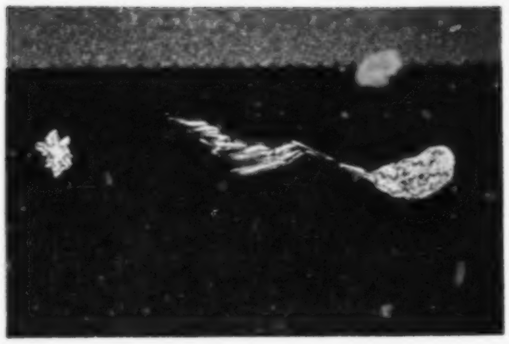
52. In the eco-system of the sea, then, light is related to warmth and to safety. Also to food.



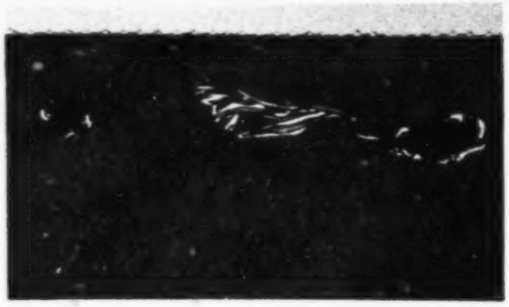
53. Earlier we learned that plants start the food-chain in the eco-system of the sea. Let us learn now how plants themselves are fed. The sea, like the land, has within it the chemicals, or fertilizer, which plants use as food.



54. The plants of the sea, often without roots, and floating on the waves, soak up these chemicals and make them into food ...



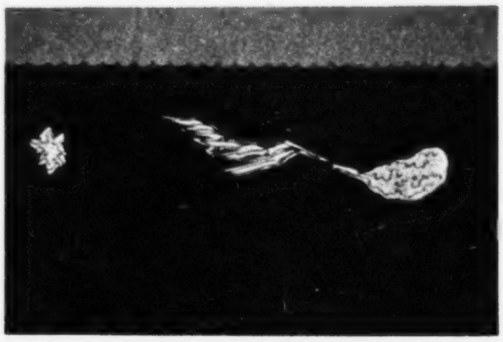
55. ... through a process called photosynthesis ... a process that works only when light is present.



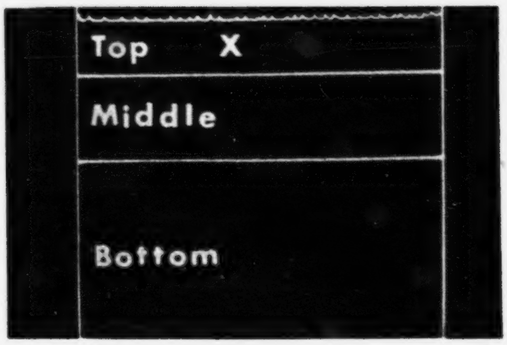
*56. Turn to page seven in your book. Look carefully at the question there. In which layer of the sea--top, middle, or bottom--do plants soak up chemicals during photosynthesis? Mark an X in your book in the right layer. (25 SECONDS NO SOUND) Now look at the screen and listen to the right answer.

BLANK SCREEN

*57. Plants soak up chemicals during photosynthesis in the top layer.

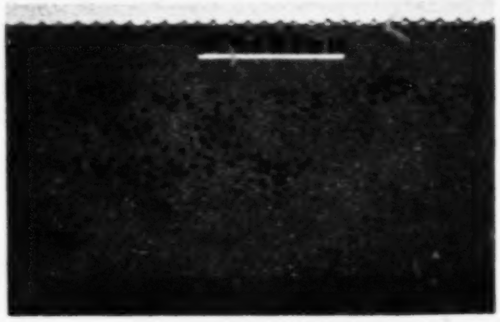


*58. From the answer on the screen, correct page seven in your book. The correct answer is the top layer.

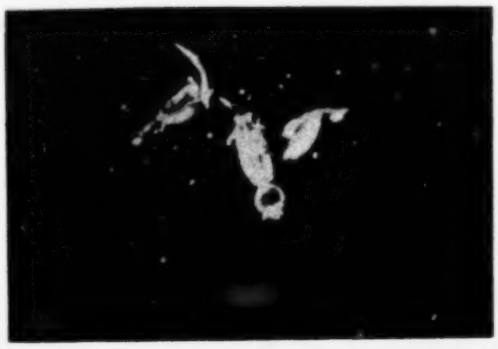


59. Where light and the right chemicals are plentiful, photosynthesis can happen in millions of tiny plants ... plants too small for one to see without help ...

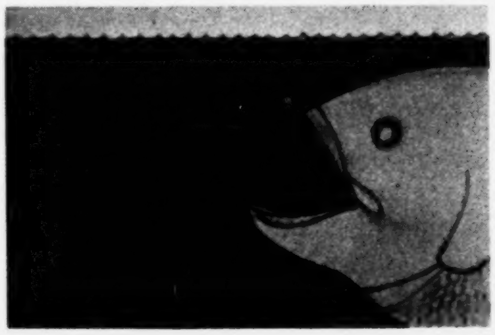
60. ... plants called plankton.



61. The same name--plankton--is given to millions of tiny shrimp-like animals which live with and feed on the tiny plankton plants.



62. The food chain in the eco-system begins with these tiny plankton: plankton plants and plankton animals.



*63. Turn to page eight in your book. Look carefully at the list of facts there. These facts need to be put in the order of their happening. Please fill in the numbers, 1 to 6, beside the facts in the list to show them in the correct order of their happening. Do this in your book. (1 MINUTE 30 SECONDS NO SOUND) Now look at the screen and listen to the right answer.

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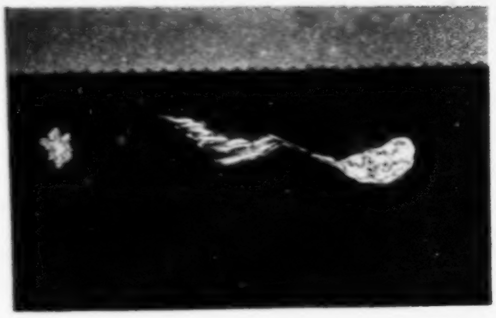
*64. There is a correct order in the food-chain by which light reaches the plants ...

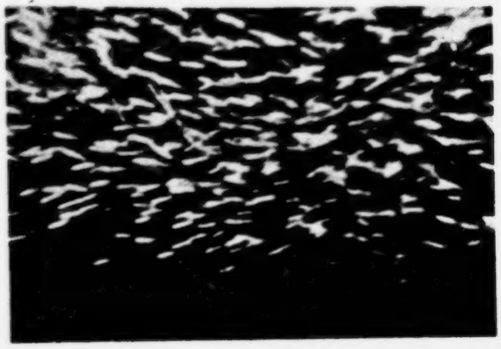
*65. ... plants soak up chemicals ...



*66. ... photosynthesis happens to feed the plants ...

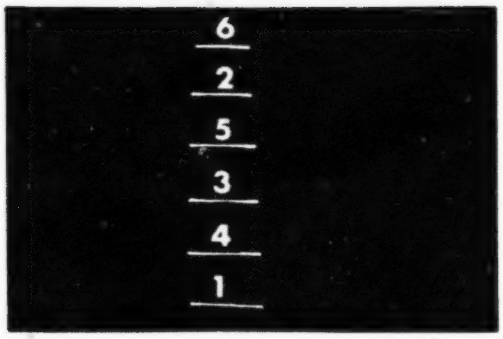
*67. ... the plants, like plankton-plants, are eaten by plankton animals ...

*68. ... these, in turn, are eaten by small marine animals ...

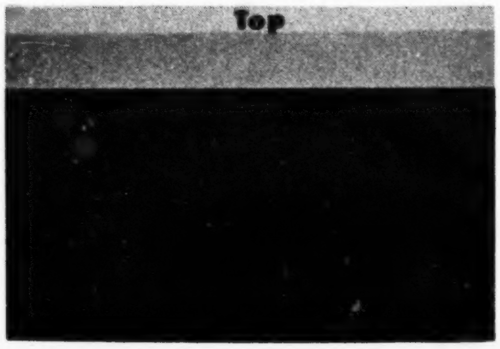


*69. ... and small marine animals are eaten by larger marine animals.

*70. From the answer on the screen, correct page eight in your book. The correct list of numbers is in this order: 6, 2, 5, 3, 4, 1.

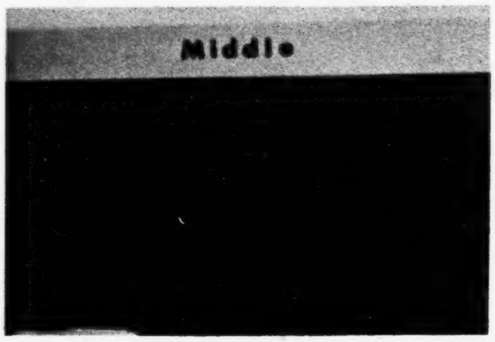


71. In this food-chain of the eco-system, we must look for plant life mainly near the top of the sea.

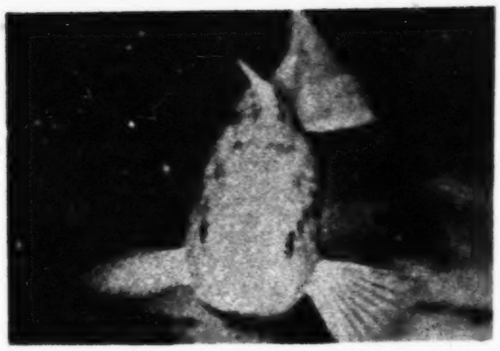


72. Marine animals in this brightly lit top of the sea eat plants and each other.

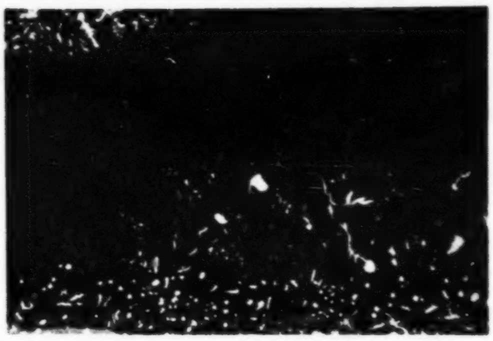
73. A little deeper in the sea, in the dimly lit middle part, different forms of marine animals also eat each other.



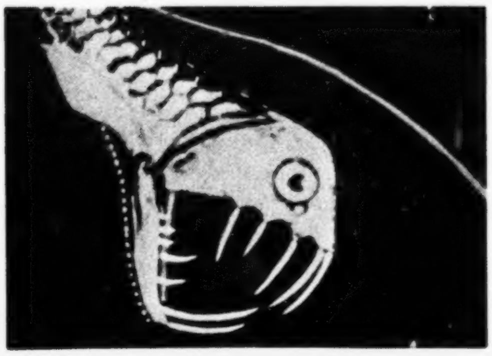
74. In addition, they eat some of the dead plants and animals which drift down from higher up in the sea.



75. But most of the dead plants and animals ... the garbage and debris of the sea ... drift down through the deep darkness below ...

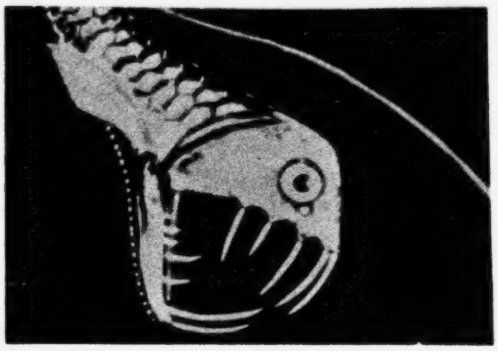


76. ... there to be eaten by very strange forms of marine animals, some of which may also eat each other.

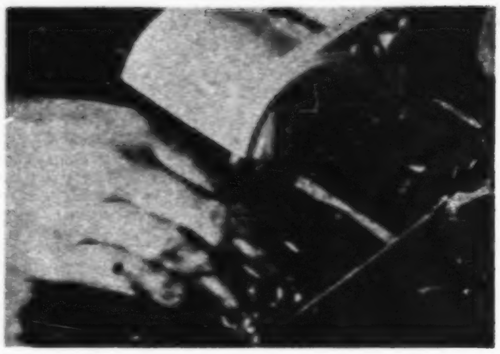


77. Miles deep through the sea is, what happens at the brightly lit top is related to ...

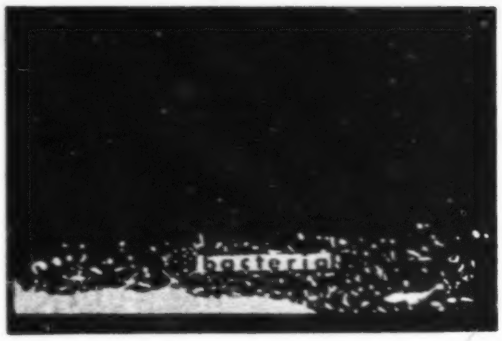
78. ... what happens at the darkest point below.



79. From the ocean floor scientists bring up ooze and clay which is as much as two miles thick at the bottom of the sea. In such mud they find signs of dead animals and plants ... and of chemicals made at the bottom of the sea by very tiny organisms.



80. These tiny organisms are called bacteria.



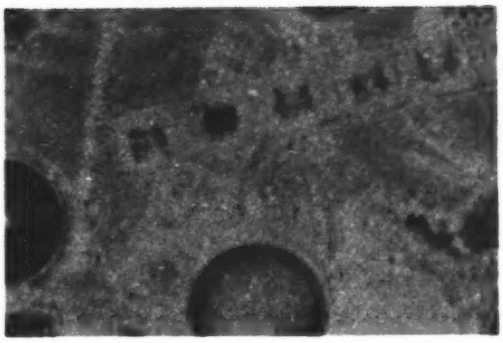
81. The chemicals made by the bacteria dissolve in the dark ocean waters ...

82. ... then rise in the moving waters to the top of the sea where plants use them for food during photosynthesis.

*83. Turn to page nine in your book. Look carefully at the instructions there. Beside each listed kind of marine life, mark where it will be found: T for at the top, M for in the middle, or B for at the bottom of the sea. Do this in your book. (45 SECONDS NO SOUND) Now look at the screen and listen to the right answers.

BLANK SCREEN

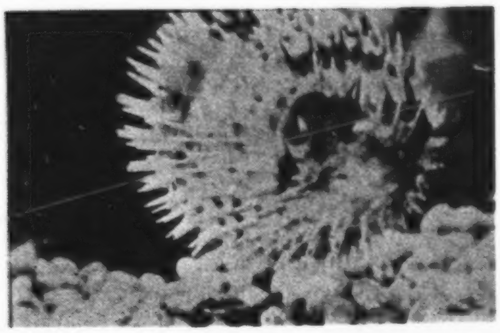
*84. In the eco-system of the sea, we find bacteria making chemicals at the bottom of the sea ...



*85. ... fish which eat plankton plants at the top ...

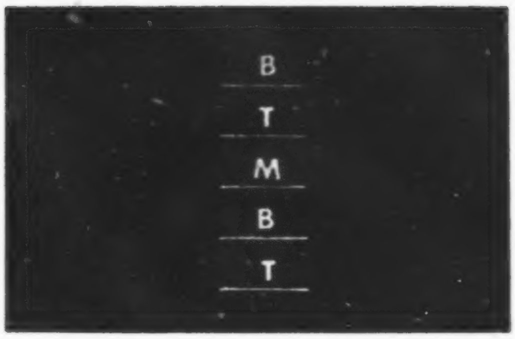
*86. ... fish which blend into blue backgrounds in the middle ...

*87. ... fish which have to make their own light at the bottom ...

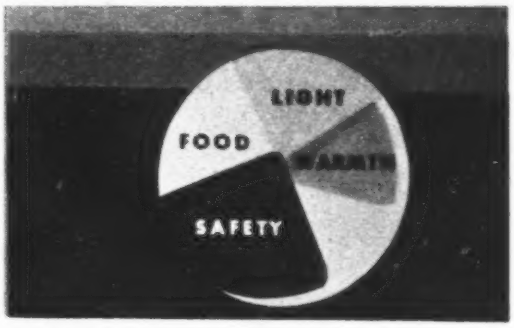


*88. ... and live plankton animals at the top.

*89. From the answer on the screen, correct page nine in your book. The correct order should read down like this: B, T, M, B, T.

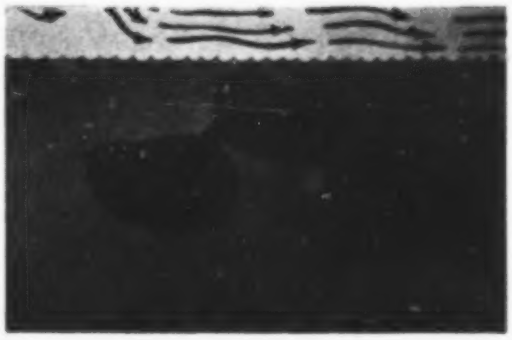


90. We have seen that light is related to warmth, safety and food in the ecosystem of the sea.

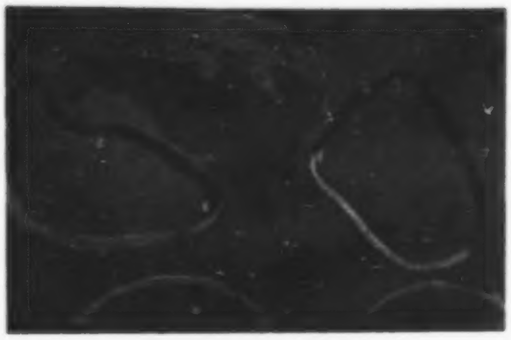


91. But the story of light and food is not complete until we learn how the dissolved chemicals come up from the ocean floor to reach the light.

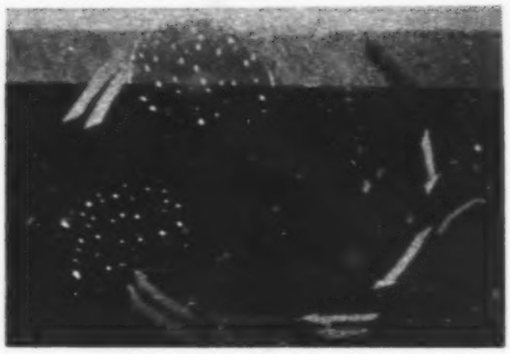
92. The sea is always in motion. Warm water at the top keeps moving away. Cold water, full of dissolved chemicals, keeps coming up from below to be warmed. But this change would be very slow were not for the winds over the sea. These winds push the warm waters away from the hot equator, making such waters flow away like rivers through the waves and tides of the sea.



93. And such currents ... as these moving waters are called ... flow away from the hot equator toward the cold poles, north and south. There the currents grow cold, sink to the bottom of the sea, then flow back toward the equator along the ocean floor ...



94. ... there to rise and replace the warm water which has moved away from the equator. It is, then, the great movements of currents, with their upward motion of water from below, which bring up the chemicals from the ocean floor for use in photosynthesis.

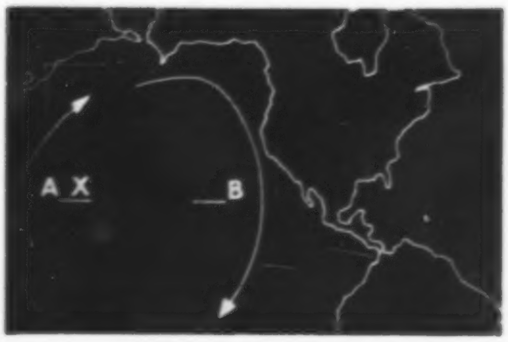


*95. Turn to page ten in your book. Listen carefully to the instructions there. On the map of the currents there, mark an X beside the letter which is next to the warm current. Do this in your book. (20 SECONDS NO SOUND) Now look at the screen and listen to the right answer.

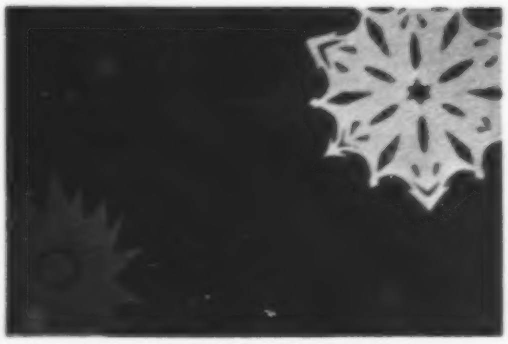
BLANK SCREEN

*96. The currents flowing away from the equator toward the north or south pole are warm currents.

*97. From the answer on the screen, correct page ten in your book. The correct answer is an X beside the letter A.



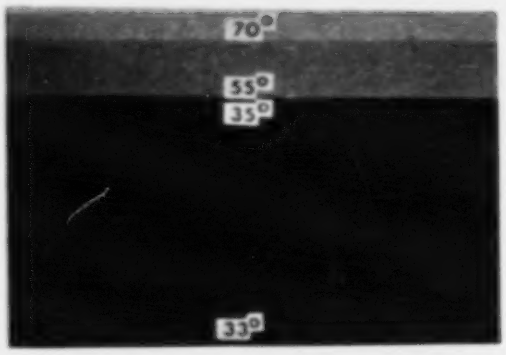
98. While nothing can halt the movement of the sea, the upward flow of chemicals can be stopped by changes in temperature at different depths of the sea. Temperatures at the top of the sea may change greatly from summer to winter, and from north to south.



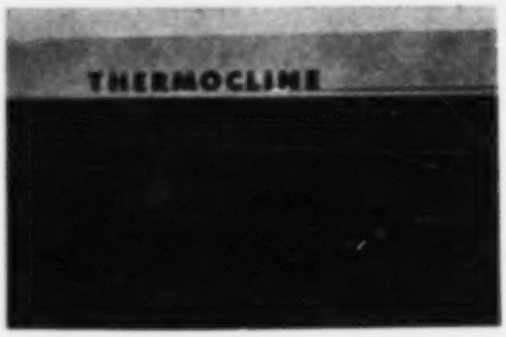
99. But in the dark bottom part of the sea, the water is always cold, though never quite freezing.

100. Where this very deep area begins, the temperature is always about 35° above zero, then drops only about two degrees in going down to the ocean floor.

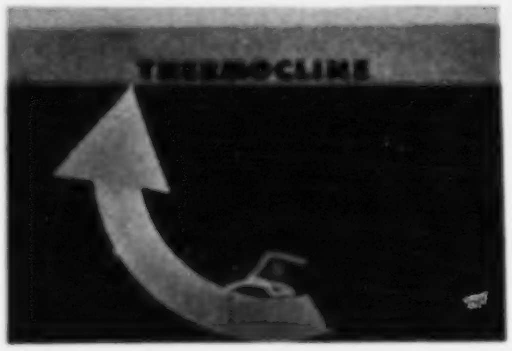
101. Though water heats and cools much more slowly than air, the temperature above the deep dark area may change a great deal.



102. What scientists call a thermocline begins where the light ends and where the sudden change to cold commences. This thermocline is like a wall between the cold waters in the deep sea and the warmer waters nearer the top.



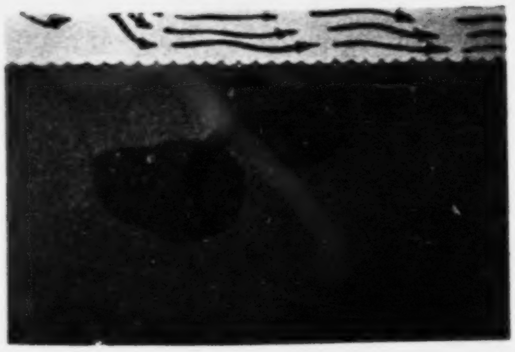
103. But this thermocline, or sharp difference in temperature, is greatest in summer when the sun warms the upper waters of the sea.



104. But in winter ... when the difference in temperature above and below the thermocline starts to disappear ... then the thermocline itself is no longer much of a wall.

105. So it is, that each winter, tons of chemicals, dissolved at the bottom of the sea ...

106. ... sweep up to the surface ...

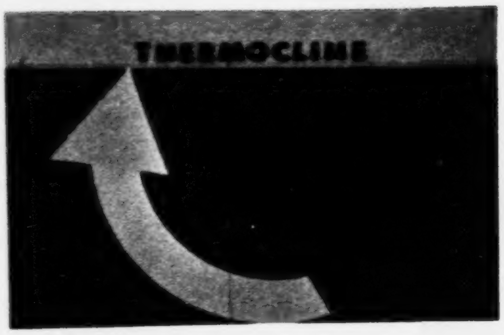


107. ... and are swept by winds and currents out to distant parts of the sea.

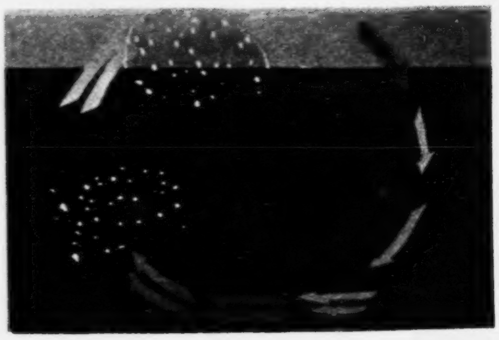
*108. Turn to page eleven in your book. Look carefully at the instructions there. The two diagrams there are of the currents and thermocline in summer and winter. Below each diagram on page eleven, write in whether it belongs with summer or with winter. (25 SECONDS NO SOUND) Now look at the screen and listen to the right answer.

BLANK SCREEN

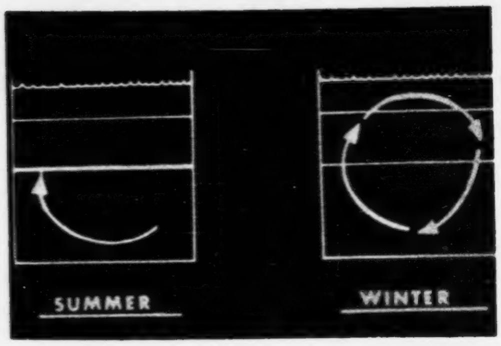
*109. The circle of the currents stops at the thermocline on the way up in summer ...

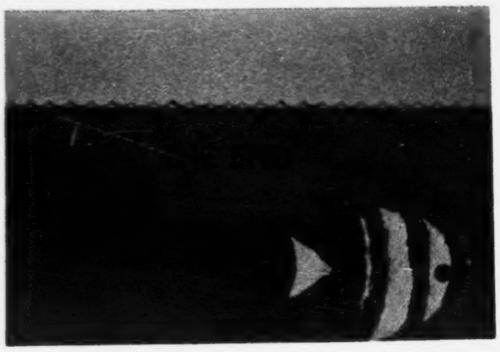


*110. ... but it breaks through to become complete each winter.



*111. From the answer on the screen, correct page eleven in your book. Correctly, you should have written summer under the diagram at the left, winter under the diagram at the right.





Covert Response with Immediate Audiovisual Feedback and Correct Answer (Film Treatment No. 2):

Because the response was "covert" rather than "overt," directions during the workbook exercises were as follows: "Do *not* write the answer, but *think* what it should be." This occurred in the following scenes: 5, 15, 25, 32, 38, 46, 56, 63, 83, 95, and 108.

Overt Response with Immediate Audio-Only Feedback and Correct Answer (Film Treatment No. 3):

During the feedback portions of the workbook exercises, directions were given to "listen to" the right answer. The audio portion only of the feedback was played as the subjects listened. This occurred in the following scenes: 5, 6 and 7; 15 and 16; 25 and 26; 32 and 33; 38 and 39; 46, 47, 48, 49, and 50; 56 and 57; 63, 64, 65, 66, 67, 68, and 69; 83, 84, 85, 86, 87, and 88; 95 and 96; 108, 109, and 110. At those places where the correct answer from the workbook was projected on the screen in Film No. 1, the screen remained blank and the answer was given in the audio track only. This occurred in the following scenes: 8, 17, 27, 31, 40, 51, 58, 70, 89, 97, 111.

Covert Response with Immediate Audio-Only Feedback and Correct Answer (Film Treatment No. 4):

The "response" portion of the film was the same as Film Treatment No. 2, and the "feedback" portion of the film was the same as Film Treatment No. 3.

Overt Response with No Feedback (Film Treatment No. 5):

All the feedback and correct answer sequences were deleted. Immediately after the correct answer was written in the workbook, the narrator said, "Now look at the screen," and the next expository sequence followed. This occurred in the following scenes: 5, 6, 7 and 8; 15, 16 and 17; 25, 26 and 27; 32, 33 and 34; 38, 39 and 40; 46, 47, 48, 49, 50 and 51; 56, 57 and 58; 63, 64, 65, 66, 67, 68, 69 and 70; 83, 84, 85, 86, 87, 88 and 89; 95, 96 and 97; 108, 109, 110 and 111.

Covert Response with No Feedback (Film Treatment No. 6):

The "response" portion of the film was the same as Film Treatment No. 2, and the "feedback" portion of the film was the same as Film Treatment No. 5.

Overt Response with Delayed Audiovisual Feedback and Correct Answer (Film Treatment No. 7):

After the response was written in the workbook, the narrator said, "Now look at the screen," and the next expository sequence followed. At the end of the entire film (after Scene 111), there was a short blank leader during which the narrator said, "Now look at the screen. Let us prepare now to correct the answers we gave earlier in this film. Turn back to page one in your book. During this film you have been asked eleven questions. Let us make sure of the correct answers." There then followed a presentation of the feedback and correction sequences, one after the other: 6, 7 and 8; 16 and 17; 26 and 27; 33 and 34; 39 and 40;

47, 48, 49, 50 and 51; 57 and 58; 64, 65, 66, 67, 68, 69 and 70; 84, 85, 86, 87, 88 and 89; 96 and 97; 109, 110 and 111.

Covert Response with Delayed Audio-Only Feedback with Correct Answer (Film Treatment No. 8):

The "response" portion of the film was the same as Film Treatment No. 2, and the "feedback" portion of the film was the same as Film Treatment No. 3 except that the feedback sequences were massed at the end of the film as in Film Treatment No. 7.

Expository No Response (Film Treatment No. 9):

Only the basic expository material in the film was shown. All the scenes marked with an asterisk (*) in the script of Film No. 1 were deleted.

Audiovisual Review (Film Treatment No. 10):

Following each of the expository sequences in the film, the "feedback" material was presented, introduced by the statement in the narration: "We have learned, then, that...." Both the response material and the correction of workbook material, contained in the following scenes, were deleted: 5 and 8, 15 and 17, 25 and 27, 32 and 34, 38 and 40, 46 and 51, 56 and 28, 63 and 70, 83 and 89, 95 and 97, 108 and 111.

Audio Review (Film Treatment No. 11):

This followed the same pattern as Film Treatment No. 10, except that the "feedback" material was presented without visuals in the audio mode only.

Massed Audiovisual Review (Film Treatment No. 12):

The basic expository material in the film was shown exactly as in Film Treatment No. 9. However, at the end of the film, the narrator said, "Let us now review the main points we have learned about the eco-system of the sea." Then followed the "feedback" material contained in scenes 6 and 7; 16; 26; 33; 39; 47, 48, 49 and 50; 57; 64, 65, 66, 67, 68 and 69; 84, 85, 86, 87 and 88; 109 and 110.

Overt Response with Immediate Audiovisual Feedback but Without the Correct Answer (Film Treatment No. 13):

This was the same as Film Treatment No. 1, except that the correct workbook answer was not shown. Thus, the following scenes were deleted: 8, 17, 27, 34, 40, 51, 58, 70, 89, 97, 111.

APPENDIX B

WORKBOOK

Name____________________________________ School______________________

PLEASE DO NOT OPEN

UNTIL ASKED TO DO SO

Page 1

Is it true or false:

When a fish empties the air from its swim bladder, it will go deeper into the water.

__________TRUE

__________FALSE

Page 2

Is it true or false?

Each form of marine life has a particular place in the sea where it usually lives.

__________TRUE

__________FALSE

Page 3

Fill in the right words where now there are blanks.

In the ____________ system of the ______________,

different forms of marine __________________ live

where they do because of their own ______________:

like safety, _________, _________, and _________.

The relationship to one another of such needs for

life in the sea is called a ____________________.

Page 4

What name do we give to what keeps marine life inside imaginary fences in order to stay alive?

Page 5

Imagine you are in a submarine 400 feet down into the sea. If you looked out into the sea, what color would the water be?

_______ a. brightly lit green

_______ b. dimly lit blue

_______ c. very black

Page 6

List three different ways in which marine animals hide from their enemies.

Page 7

In which layer of the sea--top, middle, or bottom--do plants soak up chemicals during photosynthesis? Mark an X in the right layer.

Top
Middle
Bottom

Page 8

These facts need to be put in the order of their happening. Please fill in the numbers, 1 to 6, beside the facts in this list to show them in the correct order of their happening.

__________ large marine life eats small marine life

__________ plants soak up chemicals

__________ small marine life eats plankton-animals

__________ photosynthesis takes place

__________ plankton-animals eat plankton-plants

__________ light reaches plants

Page 9

Beside each listed kind of marine life, mark where it will be found: T for at the top, M for in the middle, and B for at the bottom of the sea.

__________ bacteria making chemicals

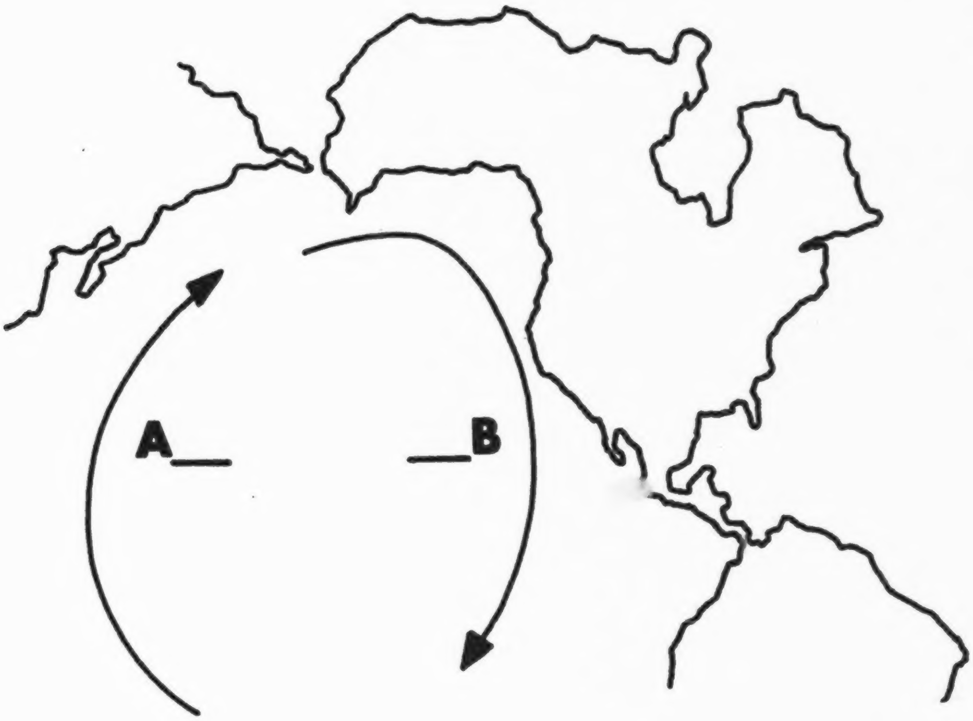
__________ fish which eat plankton-plants

__________ fish which blend into blue background

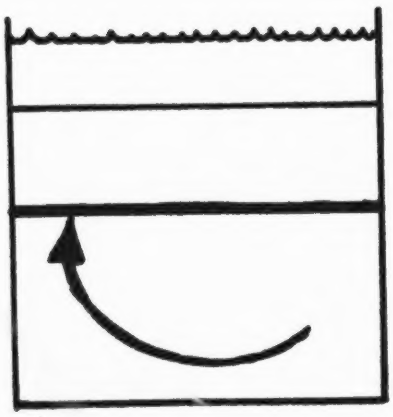
__________ fish which have to make their own light

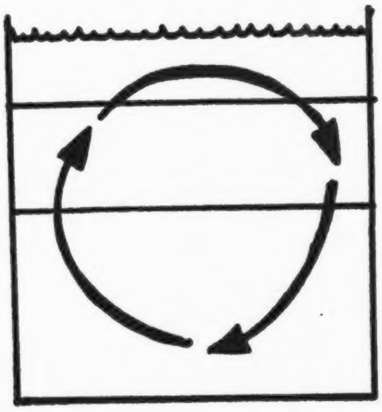
__________ live plankton-animals

On the map of currents shown below, mark an X beside the letter which is next to the warm current.



The two diagrams shown below are of the currents and thermocline in summer and winter. Below each diagram, write in whether it belongs with summer or winter.





APPENDIX C

PERFORMANCE TEST

The correct answers are indicated in the Performance Test by underlining in the case of the multiple-choice items or by the insertion of all the acceptable answers for the constructed responses.

The Knowledge Subtest items were as follows: 1, 2, 3, 4, 6, 8, 9, 10, 12, 16, 19, 20, 21, 27, 28, 31, 34, 36, 38, 40, 43, 44, 45, 47, 49, 51, 55, 58, 62, 63, 64, 65.

The Comprehension Subtest items were as follows: 7, 11, 18, 22, 24, 25, 26, 32, 37, 41, 42, 43, 46, 50, 52, 53, 54, 56, 57, 66.

The Application Subtest items were as follows: 5, 13, 14, 15, 17, 23, 29, 30, 33, 35, 39, 48, 59, 60, 61, 67.

The items practiced in the Workbook were as follows: 3, 5, 8, 10, 16, 24, 34, 36, 40, 44, 46, 49, 51, 52, 62, 63, 64, 65, 66.

The items Not Practiced in the Workbook were as follows: 1, 2, 4, 6, 7, 9, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 37, 38, 39, 41, 42, 43, 45, 47, 48, 50, 53, 54, 55, 56, 57, 58, 59, 60, 61, 67.

1. The planet earth is covered with ______________ water.

    1) 60%
    2) 65%
    3) 70%
    4) 75%

2. Where in the sea would you expect to find no life?

    1) wherever it is too dark
    2) only where the water is cold
    3) life is everywhere
    4) in places where it is very deep

3. Fish live where they do in the sea because they must

    1) search for chemicals to make food
    2) meet their own special needs
    3) have light for photosynthesis
    4) find warm temperatures

4. Some forms of marine life eat other forms, which are in turn eaten by still other forms. We call this relationship

1) a food chain
2) a circular motion
3) photosynthesis
4) the Law of the Limits

5. If we were to choose a word to describe how our safety is related to light, and light to the warmth of the earth, and those to the food we eat, we might call this pattern a

1) limit
2) chain
3) system
4) circle

6. Each form of marine life

1) eats most plants and animals
2) must be kept warm
3) must have light to grow
4) needs its own kind of food or chemicals

7. As part of the food chain of the sea, a fish is apt to be

1) disobeying the Law of the Limits
2) trapped by fishermen
3) safe among plants
4) eaten by other fish

8. The pattern of needs that makes all animals and plants in our world live where they do is called the eco-system;
ecological system;
law of the limits

9. In the food chain of the sea, plants become food for animals; fish;
plankton animals;
plankton fish

10. It was said in the movie that animals and plants living in the sea have four basic needs, these are:

1) light, chemicals, food, and photosynthesis
2) safety, chemicals, food, and light
3) chemicals, food, warmth, and safety
4) warmth, light, safety, and food

11. What would happen to marine animals if all marine plants were to die?

they would die; they would starve; all would die;
there would be no marine animals left

12. A limit is

1) a law
2) the edge of an area
3) a little bit of something
4) the outside of a thing

People don't live under water because of the fact that they have a need for air in order to live. This is an example of the Law of the Limits as it affects human beings. Give two of your own examples of the Law of the Limits at work in the world around us.

13)

14) Accept reasonable applications of the Law of Limits:
we need water, warmth, food, etc.; fish can't live
on land; we can't live in space; people need food;
we need oxygen; we must be safe

15. Imagine that we have found a small, strange creature struggling in a shady pool of water along the shore. It seems quite at home under water. It looks like a fish, yet it has fur. When we pick it up and look at it in the sunlight, it stops struggling and seems comfortable out of the water. In accordance with the Law of the Limits, we might conclude that the creature is a

1) strange kind of fish caught in a tidal pool
2) very young sea bird
3) land mammal lost along the shore
4) sea mammal trapped in a tidal pool

16. When scientists say "eco-system," they mean

1) fish and plants that have similar needs
2) sounds that reflect in patterns
3) only fish and plants that live in the sea
[✓ 4) all living things have related needs]

17. The Law of the Limits

1) determines the position of plants and animals in the food chain
[✓ 2) applied to all living things]
3) determines the number of fish living in the sea
4) applies only to marine life

18. If the earth were surrounded by water instead of air, we would expect ____________________ light to reach us from the sun.

1) a little more
[✓ 2) much less]
3) a little less
4) much more

19. In clear water, the warm rays of the sun penetrate about ____________________ into the sea.

1) 150 feet
2) 850 feet
3) 7 miles
[✓ 4) 250 feet]

20. Which color light ray penetrates deepest into the sea?

blue; violet; blue-violet; dim blue; dark blue;
dark purple; purple; ultra violet (has to be cold color)

21. Most of the sea is

1) dim
[✓ 2) dark]
3) very light
4) light

22. Which of the following best describes the way in which sunlight penetrates the sea?

1) both warm rays and cool rays penetrate all the way to the bottom
2) warm rays penetrate more deeply than cool rays
3) warm rays may be found only near the surface
4) only the cool rays penetrate all the way to the bottom

23. If a fish has a silver-colored belly,

1) enemies below it cannot see it clearly
2) it will look like marine plants
3) enemies above it cannot see it clearly
4) it will stay in the sand on the bottom

24. Animals in the sea have many ways to escape being eaten. One example would be that some

1) eat plants
2) are blind
3) big fish eat only little fish
4) are varied in color

25. Suppose a certain kind of fish is found in only one part of the sea, what might we conclude about its needs?

needs are met there; needs are found there; its needs are in this one area; it needs what is there; it must be there for its food, warmth, light and safety

26. Some fish can luminesce, that is, can produce their own light. Those fish would probably be found

1) where enemies are many
2) near the bottom
3) in the dim part of the sea
4) under rocks

27. Plants use ____________________ to make their food.

1) chemicals
2) bacteria
3) plankton
4) fish

28. The process whereby plants produce sugar in the presence of needed chemicals, water, and light is called photosynthesis.

29. If you were trying to grow sea plants in a tank, and you had correct amounts of light, chemicals, fish, and sea water at the right temperature, you would probably fail because

1) photosynthesis would stop
2) there would be no wind
3) there would be no currents
4) it has to be the right season

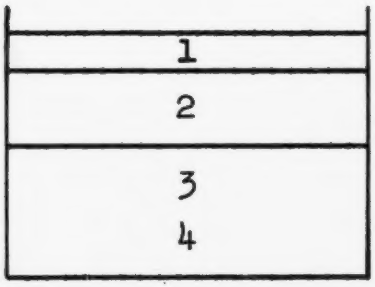
30. In accordance with the Law of the Limits, we will find that moss grows on the shady side of trees in our forests because

1) the temperature is too low on the other side
2) it needs less light than most plants
3) there is more water there
4) there is less wind

31. The food chain in the eco-system of the sea begins
with plants
plankton plants

32. In this profile of the sea, which of the numbered areas will contain most plants.

1)
2)
3)
4)



33. The most important difference between plants and animals is that

1) plants make their own food
2) animals can move about
3) animals have legs
4) plants have roots

34. Tiny living organisms found near the surface of the sea are called

1) plankton
2) bacteria
3) fish
4) plants

35. There are fewer animals in the sandy desert than in many other places on earth because

1) it is very hot in the daytime
2) most animals do not like sand
3) few plants grow there that can be eaten
4) there is no place to hide

36. The imaginary fence that keeps marine plants and animals within their own special place is called the Law of Limits.

37. Plants of the sea and grass of the earth are both found near the surface because

1) they both have roots
2) they are safest there
3) they both need chamicals
4) they both need light to make food

38. Plankton is

1) fish
2) plant only
3) animal only
4) both animal and plant

39. We know from the movie that dead animals and plants sink in the sea and become food for the fish that live at the bottom. Briefly, give an example of how what happens at the top of the sea is related to what happens at the bottom.

food comes from the top; food chain; chemicals rise to the top; fish (or plants) that die at the top go to the bottom, are changed to chemicals which rise to the top; plant food comes from the bottom

40. The tiny organisms that assist in the decay of dead plants and animals are found

1) at the thermocline in the sea
[✓ 2) at the bottom of the sea]
3) in the dimly lit area of the sea
4) in parts of the sea with most sunlight

41. We know that animals and plants live where they do because of their different needs; therefore, if they went somewhere else,

1) they could not return
[✓ 2) they would have to change or die]
3) they would have no difficulties
4) it would be uncomfortable but safe

42. Even in its darkest part, the sea is

[✓ 1) in motion]
2) warm
3) full of plants
4) free of chemicals

43. In the deepest parts of the sea, the water temperature

[✓ 1) is always low]
2) changes with the seasons
3) is highest near the equator
4) changes with the weather

44. Most of the warm water in the sea moved toward the

1) thermocline
2) shore
[✓ 3) poles]
4) limit

45. Temperatures at different levels of the sea are

[✓ 1) very different]
2) about the same
3) slightly different
4) exactly the same

46. Which of the following best describes the movement of the sea?

1) cool water moves toward the poles and rises to be warmed
2) the wind cools the sea, and cold water sinks
3) warm water moves toward the poles, sinks, and moves back to be warmed
4) the sea moves up and down with the winds and back and forth with the seasons

47. The rivers of the sea are called ________________.

1) waves
2) currents
3) movements
4) gulfs

48. The warm and cold air in this room are in motion. We have seen that warm and cold currents in the sea are also in motion. Briefly describe how the motion of the air and the sea are alike.

warm air cools and is displaced; they both move in a circle; warm to top, cold to bottom; cold at bottom and warm at top; warm air rises and cool air drops; they both move in currents; move in same direction

49. The chemicals used by plants in photosynthesis come from the

1) sun
2) thermocline
3) land
4) bottom of the sea

50. The sea heats and cools ________________ the air.

1) much faster than
2) faster than
3) the same as
4) slower than

51. At certain times of the year, there is a greater difference in temperature between the lighted surface and the darker depths of the sea than at other times of the year. The level at which the temperature of the sea changes abruptly is known as the

1) Law of the Limits
2) top
3) seasonal current
4) thermocline

52. The difference between the temperature at the surface and the temperature at the bottom of the sea is:

[✓ 1) greatest in Summer, least in Winter]
2) least in Fall, greatest in Spring
3) least in Summer, greatest in Winter
4) greatest in Fall, least in Spring

53. Currents of air, or winds, are very important to life in the sea because winds

1) slow the movement of the sea
[✓ 2) help form rivers or currents in the sea]
3) move debris along the bottom of the sea
4) allow light to reach sea animals

54. The temperature near the surface of the sea is higher than it is deeper down because

1) the bottom of the ocean is always cold
[✓ 2) light and heat go only so deep]
3) there is more movement near the surface
4) currents carry warm water to the surface

55. The temperature near the bottom of the sea is about

[✓ 1) 33]
2) 35
3) 55
4) 70

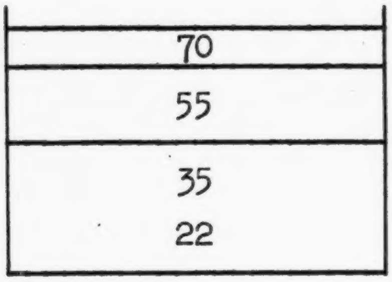
56. Briefly tell how dead marine animals and plants are used in the food chain of the sea:

decayed by bacteria, which produce chemicals, which feed plants; are eaten by other animals (fish) at the bottom; they are changed into chemicals; bacteria make chemicals; they are changed into food; they are eaten as they sink; they are eaten at the bottom

57. Most animals and plants of the sea obey the Law of the Limits and therefore

1) often move from the top to the bottom of the sea
2) hibernate for the season
[✓ 3) avoid dangerous changes in temperature]
4) stay on the bottom of the sea

58. In the profile of the sea shown below, one temperature is in error. Choose the temperature that would correct this error.



1) 35 should be 38
2) 55 should be 60
3) 22 should be 33
4) 70 should be 75

59. On land, warm-blooded animals move freely from relatively low temperatures to relatively high temperatures. Whales, porposes, and turtles are warm-blooded animals, therefore we would expect them to

1) be found only in the warmest parts of the sea
2) remain near the land on the floor of the sea
3) stay as close to warm land as possible
4) be comfortable at most depths in the sea

60. The complex machinery and great care used by men when they go down into the sea shows that

1) the Law of the Limits applies to them too
2) it is difficult to imitate fish
3) the sea is always in motion
4) fish can disobey the Law of the Limits more easily than men

61. On most smoggy days, there is a layer of very warm air over cooler air near the ground. From what you have learned in the movie, you would call this wall between warm and cool air a

1) Law of the Limits
2) system
3) thermocline
4) wave

The four basic needs of animals and plants in the sea are:

62. food,

63. light, (In any order)

64. warmth,

65. safety.

66. Each plant or animal has its own needs; because of this,

1) each form is usually found in a particular place
2) plants and animals have the same needs
3) plants grow everywhere in the sea
4) fish and plants both need light to live

67. A scientist wishes to use sunlight to light his aquarium, but he wishes to keep the dangerous warm rays of the sun away from the fish who live there. To do this he might

1) shine the sunlight through water to let only the cool rays reach the aquarium
2) put ice in the aquarium to keep the fish cool
3) keep the water in the aquarium from moving
4) change the Law of the Limits

APPENDIX D

QUALITATIVE MEASURES

Name ______________________________
Last Middle First

School ______________________________

IDENTIFICATION NUMBER

0	1	2	3	4	5	6	7	8	9
0									9
0									9
0	1	2	3	4	5	6	7	8	9

BE SURE TO MAKE YOUR MARKS
HEAVY AND BLACK

ERASE COMPLETELY ANY ANSWERS
YOU WISH TO CHANGE

FILL IN SEX BOY GIRL

THE STORY YOU SAW ABOUT
THE ECO-SYSTEM.

U. S. C. CINEMA RESEARCH

GOOD	3	2	1	0	1	2	3	BAD
WORK	3	2	1	0	1	2	3	PLAY
CRUEL	3	2	1	0	1	2	3	KIND
FAST	3	2	1	0	1	2	3	SLOW
STRONG	3	2	1	0	1	2	3	WEAK
PLEASANT	3	2	1	0	1	2	3	UNPLEASANT
REPETITIVE	3	2	1	0	1	2	3	VARIED
FEMININE	3	2	1	0	1	2	3	MASCULINE
LOUD	3	2	1	0	1	2	3	SOFT
ACTIVE	3	2	1	0	1	2	3	PASSIVE
HEAVY	3	2	1	0	1	2	3	LIGHT

IBM 614

CIRCLE THE BEST ANSWER (4 Mins)

1. Did you feel that the story about the eco-system of the sea was __________________?

   a) very long b) long c) OK d) short e) very short

2. How did you feel about the story when it was shown to you?

   a) liked it a lot b) liked it a little c) just OK d) disliked it a little e) disliked it very much

3. Which part did you like best?

4. Which part did you like least?

5. Did you have any trouble understanding it? Mark an X for Yes________, or for No________. If you have trouble, tell what this trouble was in the space below.

6. How much do you think you learned?

   a) very little b) a little c) just OK d) a lot e) a great deal

7. Was the test________________?

   a) very easy b) easy c) OK d) hard e) very hard

8. If you used a workbook during the story, how did you feel that it helped you to learn?

   a) not at all b) a little c) just OK d) a lot e) a great deal

APPENDIX E

TABLE 21

CORRELATION COEFFICIENTS
(N = 381)

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	TOTAL TEST	1	100	95	91	81	-11	76	78	67	69	69	80	65	45	61	51
Subtests	Knowledge	2		100	79	65	-12	70	71	61	64	64	74	61	43	58	47
	Comprehension	3			100	65	-9	68	72	61	62	61	73	58	40	54	47
	Application	4				100	-6	64	67	58	59	59	67	56	37	51	42
	Sex	5					22	-5	-8	16	-2	-5	-1	1	3	2	12
Iowa	Vocabulary	6						90	81	73	69	67	87	75	41	64	48
	Reading	7							91	71	76	71	89	74	46	66	45
	Language	8								91	77	75	88	75	55	72	55
	Work-Study	9									90	81	90	72	58	72	61
	Arithmetic	10										92	89	68	56	69	56
	Composite	11											99	81	58	78	59
CTMM	Language IQ	12												99	58	86	50
	Non-Language IQ	13													99	91	49
	Total IQ	14														99	56
	Total F Battery	15															100

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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION

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TITLE

Learner Response, Feedback and Review in Film Presentation
(Final Report)

PERSONAL AUTHOR(S)
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INSTITUTION (SOURCE)
University of Southern California, Los Angeles, Cal., Dept. of Cinema

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RETRIEVAL TERMS

IDENTIFIERS

ABSTRACT

The effectiveness of a general science sound motion picture film on "Oceanography" was compared when designed to incorporate three different methods of eliciting active learner response (overt, covert, no response), by five different methods of giving the learner knowledge of the correctness of the response (spaced audiovisual or audio feedback with correct answer, spaced audiovisual feedback without correct answer, delayed massed audiovisual feedback, no feedback), and by three different methods of review (spaced audiovisual, spaced audio, delayed massed audiovisual). Study consisted of 13 experimental treatments combining the response, feedback and review variables. Subjects were 477 sixth grade students. Performance was measured by post-test of knowledge, comprehension and application, analysis of variance and covariance, factor analysis, correlation analysis, t-test, and qualitative measures. Results: (1) A basic conventional film (without inclusion of experimental variables) resulted in learning as great as in experimental treatments. (2) Giving feedback of correctness of response was more effective than no feedback. (3) There were no significant differences in learning between overt and covert response groups or for the review conditions. (4) All groups responded positively to the material presented.

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